Sustainable Development: A Framework for Governance

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Abstract/Résumé analytique

The implementation of sustainable development is the social imperative of the 21st century, requiring strong leadership by governments at all levels. As the logical convenor of constituent groups in civil society, governments have a key role to play in diffusing its concepts and practices in the next decade, before critical thresholds are reached. This role will not be realized, however, without a guiding framework across governments that provides consistent and effective leadership to other sectors of Canadian society, equally supported by a new framework for governance based on human responsibility and the interconnectedness of human and natural systems. These frameworks are grounded on the reconciliation of three imperatives, the ecological, the social and the economic, based on analogues taken from ecological systems. Principles such as integrity, cyclical processes, resilience and systems approaches are key, as are the many alternative paradigms circulating within society capable of providing new information about the ways in which our systems operate.

La réalisation du développement durable semble être la réalité sociale du XXI[e] siècle. Elle exige un leadership solide de la part de tous les paliers de gouvernement. À titre de responsables logiques des groupes formant une société civilisée, les gouvernements ont un rôle important à jouer dans la diffusion des concepts et des pratiques de ce développement au cours de la prochaine décennie, avant qu'on ne franchisse des seuils critiques. L'exécution de cette tâche exige l'existence d'une structure directrice commune à tous les gouvernements offrant un leadership conséquent et efficace aux autres secteurs de la société canadienne profitant de l'appui d'une nouvelle structure de direction fondée sur la responsabilité humaine et les liens communs entre les systèmes humains et naturels. Ces structures sont fondées sur la conciliation de trois réalités, écologique, sociale et économique, à partir d'analogues provenant des systèmes écologiques. Des principes tels que l'intégrité, les procédés cycliques, la résistance et les approches utilisées par les systèmes représentent la clé, tout comme les nombreux autres paradigmes qui existent au sein d'une société capable de fournir de nouveaux renseignements sur le fonctionnement de nos systèmes.

Claims to Originality

Because of the highly integrated nature of this dissertation it may be difficult to recognize what is specifically my own contribution. Because all contributions, including those from the co-researchers, are directly referenced, what remains represents my contribution. But, more than this, what I believe I have provided is the following.

Research Methodology:

1. a unique synthesis of participatory research methodologies was employed, as detailed in Appendix E (collaborative inquiry model);
2. electronic collaborative inquiry was used of 20 Canadian co-researchers to bring together academics and public policy practitioners in an ongoing dialogue, selected on the basis of their expertise, gender and regional sensitivities;
3. integration of process under investigation, sustainable development and research methodology (collaborative inquiry); and
4. a peer review process by 26 selected senior government experts was used to test the models and ideas.

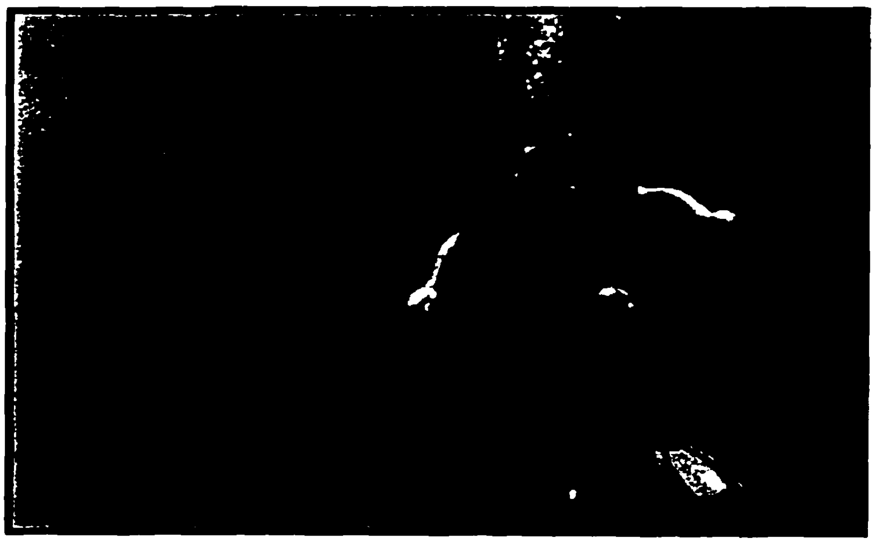
Theory:

1. open policy dialogue process was developed (Figure 10.2);
2. a framework for governance was developed (Figure 10.4);
3. institutional characteristics that support sustainable development were identified (Table 9.1);
4. a guiding framework of principles that underpin decision-making for sustainable development was developed;
5. a model of restraining forces for the implementation of sustainable development in Canada was developed (Figure 8.1); and
6. a unique synthesis, based on the literature from a wide range of disciplines was prepared.

Products:

1. two collaborative inquiry research workshops with 25 participants were conducted (Norway and Vancouver);
2. an archival website (http://www.sdri.ubc.ca/addialogue) was created; and
3. an ongoing network of 10 scholars from across Canada has developed.

In memory of my beloved son, Daniel James Frazer
September 19, 1966 — May 10, 1998



Acknowledgments

When I first began my doctoral studies, I thought that I had begun an entirely new journey, a new pathway that was unique, until one day, I pulled out a very short paper I had written in 1974 on Organizational Behaviour as part of my studies at the Masters' level. There were remarkable similarities between that paper and my doctoral abstract prepared in 1995. Just as my doctoral learning about ecological system function, structure and processes has taught me that systems are sometimes chaotic, random, sometimes stable and discontinuous, there is at the same time, some sort of remarkable continuity at play that transcends the individual. As Koestler (1978) has remarked, "The death of the part is necessary for the life of the whole", so I have learned that my work towards my doctorate has been a remarkable continuum, sometimes chaotic, random and yet, with an emergent integrity that is largely due to the people with whom I have had the privilege of working.

I would like to first thank my mother, Catherine, from whom I inherited a strength of mind that has allowed me to continue on in spite of some terrible losses, and my father, who gave me the gift of myself, separate from gender expectations. And my sister, Elaine, who has been a constant source of support and wise advice. Lastly, I would like to thank my husband, Bill and my beloved child, Daniel James, who gave me so much and from whom, at times, I took so much time in order to be able to focus with that incredible intensity that is so necessary for creative work. Without doubt, my doctoral work has taken time from my family, and many times, I put those relationships I most cared for to the side, thinking I could get back to them later. Danny was my spell checker, my keeper of integrity.

In terms of my professional colleagues, I am honoured to count many people who are both colleagues, friends and mentors, who have shared unstintingly of their intellect, time and support through this incredible journey of reconciliation. My co-researchers were wonderful collaborators on this journey, ensuring the pathway we took had meaning. I would particularly like to thank David Brown, Caterina Geuer, Nina-Marie Lister, Christine Massey, Shealagh Pope, and David Sims for their contribution, both personal and professional. I would also like to thank John Robinson, Director of the Sustainable Development Research Institute at the University of British Columbia for sharing so generously of his culture and intellect. I would also like to thank the members of my committee, who have given me such compassionate professionalism -- Valerie Behan-Pelletier, Scientist, Agriculture and Agri-Food Canada; John Henning, Faculty of Agricultural Economics, McGill University; David Johnston, Centre for Medicine, Ethics and Law, McGill University; Jim MacNeill, Chair of the International Institute for Sustainable Development; Frances Westley, Faculty of Management, McGill University and lastly, Stuart Hill, Foundation Chair, School of Social Ecology, University of Western Sydney at Hawkesbury. Stuart has given me unqualified support, both personally and intellectually, making this journey almost enjoyable in spite of some of the painful bumps and ruts we encountered upon the road. He truly demonstrated the importance of the "personal imperative" and its integration into the professional sphere, and I could not have completed this journey without him.

I am indebted to the staff of the Environment Canada departmental library for their unfailing reference support, in particular, Judy Patterson, Marie Jetten, and Claire Paquet.

To all of the people above, and to some unnamed, une mille fois merci.

1

Introduction

The problem of grace is fundamentally a problem of integration and that what is to be integrated is the diverse parts of the mind—especially those multiple levels of which one extreme is called "consciousness" and the other the "unconscious". For the alignment of grace, the reasons of the heart must be integrated with the reasons of the reason.
(Bateson 1972, p. 129)

We indeed live in the best of times and the worst of times (Dickens 1859). Paradoxically, much of what appears to be growth and development may actually be decline. The collapse of the Berlin Wall and the former Soviet Union means there has never been greater opportunities for democracy worldwide, while at the same time, the level of ethnic and regional conflicts has never been greater. We increasingly recognize the importance of plurality and diversity of human societies worldwide, while homogenization through globalization accelerates. The spread of post-modernist thought is paralleled by a worldwide trend in fundamentalism. We live in an information age and yet, most remain fundamentally ignorant of most key ecological processes. Overall wealth is increasing at the same time as income disparities are widening. We have the technology to put a man on the moon and yet, we do not know anything about, nor have we even named, most of the species on our planet, many of which are threatened with extinction. We can explore Mars and yet, the internal combustion machine, which has not fundamentally changed since it was invented in the 18th century continues to pollute our planet. We produce arms and then sell them to countries who then turn around and use them against us. Moreover, over half of the scientists in the world are engaged in arms and war related research. It is indeed a paradoxical time, as biophysical evidence continues to mount that the products of our growth and associated consumption patterns are slowly destroying the habitat on which our very survival depends, our home.

While finalizing my research proposal in the summer of 1996, one of my best friends died very suddenly and at a young age. Once in a while, a special person or animal walks into your life. Mamut was such a being, he was the gentlest creature I have ever had the privilege of knowing. Since his death, the words, "compassion for all living beings and doing no harm", keep reverberating.

...a good sense of the felt texture of involvement in human affairs—something which is always part logical, part irrational, part farce and part tragedy, with human affairs themselves always, in the end, unpredictable.
(Checkland and Scholes 1990, p. 275)

Paradoxes, however, can be viewed simultaneously as both crises and opportunities. The solutions we seek for moving to more sustainable societies worldwide may well lie in learning to reconcile the tensions within these paradoxes, rather than denying their existence because we feel powerless to change our current human planning, decision-making and activity systems. The perception of paradoxes as crisis or opportunity depends very much on where one is located in what Foucault (1980) refers to as "power/knowledge" systems. As the following chapters outline, feelings of powerlessness allow us to continue living in massive denial of our present ecological reality, as we degrade our current, and some analysts (Capra 1996; Daily et al. 1997; Earle 1995; Ehrlich 1977; Gordon and Suzuki 1990; Hill 1975; Meadows et al. 1992; Odum 1973; Rees 1996) would argue, our future ecological capital, at an unprecedented rate and scale. This thesis is one result of my efforts to address the above paradoxes within a framework of sustainable development. In addition to reviewing the literature in the areas of ecology, sociology and economics, and reflecting on the interrelationships between them, I involved a group of 20 scholars and public practitioners from across Canada in an electronic dialogue, based on the principles of participatory action research (Heron 1988; Reason 1994; Rowan 1981).

> *The chances for true creativity are seen in overcoming a dualism which separates the created from the creator.*
> (Jantsch 1980, p.17)

The central assumption of my dissertation is, therefore, that *the implementation of sustainable development is the social imperative of the 21st century, requiring strong leadership by local, regional and national governments. A guiding framework across governments is critical to their ability to provide consistent and effective leadership to other sectors of Canadian society, in order to diffuse its concepts and practices in the next decade, before irreversible thresholds are reached.* Human activity, as implied in the notion of sustainable development affects three broad external systems: the ecological, the social and the economic (a history of the concept of sustainable development is included in Appendix A), all of which are ultimately dependent on the development of one internal system: the individual. It is counter-productive to debate which is more fundamental. Addressing all four is both necessary and sufficient.

There are two inter-related levels of human activity — personal and political, which are often mistakenly separated. This dissertation focuses on the latter and its organizational implications, as I assume that sustainable development will not be realized without effective government leadership in order to more rapidly diffuse sustainable development concepts and practices in the next decade. I have also assumed that the socio-economic system is a closed rather than an open system and that human activity systems are a part of natural systems, that have biospheric limits. Moreover, human behaviours are greatly influenced by dominant myths, metaphors and paradigms that influence and affect how we organize our activities at all levels of society.

My story begins with a description of my research methodology. I chose a form of participatory action research (Heron 1996, Reason 1994), in an attempt to influence public policies in sustainable development. Since totalizing theories and expert prescriptions (Lather 1991) are antithetical to sustainable development praxis, I collapsed two variants from normal participatory action research — co-operative inquiry and collaborative inquiry — engaging co-researchers in a national electronic dialogue. Based on participatory values rather than coercive values (Harding 1987), and the belief that ways of knowing are inherently culture-bound and influenced by dominant paradigms, my methodology of electronic collaboration is an openly ideological approach to critical inquiry and the necessity of self-reflexivity, or growing awareness of how researcher values permeate inquiry (Lather 1986). It deliberately exposes and articulates collective and individual values, making these perspectives an inherent part of the scholarship. In addition, it reflects my belief in the need to integrate both process and product. Thus, in my research process I have endeavoured to mirror principles and practices of sustainable development, as these both inform and influence one another. And I have used foundational uncertainty deliberately to create a post-paradigmatic diaspora (Caputo 1987) to both empower those involved in change, as well as attempt to influence policy and its resonance in the lives of people outside of academe (Bromley 1989; Lauder and Kahn 1988; Shapiro 1989, and Wexler 1987). I have done this particularly by sending copies of a draft of this dissertation to 26 highly placed public servants for feedback and comments, the hope being that they would be influenced by the ideas in the document as they reflected upon it in relation to their organizational context.

Sustainable development can be regarded as a process of reconciliation of three imperatives: (i) the ecological imperative to live within global biophysical carrying capacity and maintain biodiversity (ii) the social imperative to ensure the development of democratic systems of governance that can effectively propagate and sustain the values that people wish to live by; and (iii) the economic imperative to ensure that basic needs are met worldwide.
And equitable access to resources— ecological, economic and social—is fundamental to its implementation.

The next chapter looks at the nature of some of the dominant paradigms affecting the organization of human activity systems, open versus closed systems, dualism and holism, resulting in the artificial separation of human activity systems from natural systems. I propose that the former are actually embedded within the latter, and that human survival is now fundamentally linked with the maintenance and resilience of natural systems.

The next three chapters examine the three political imperatives, the ecological, the social and the economic. These literature review chapters argue that from the ecological, social and economic evidence it is clear that we must embrace a new paradigm, adopt new metaphors and create new space for policy alternatives that emphasize adapting our behaviour to our current ecological reality. I have chosen in Chapters 4 to 6 to stress the negative side of the ledger when addressing each of the three imperatives, although there are numerous positive sustainable development examples now emerging in all sectors of society. On balance, however, because the negative side of the ledger remains so great, that in the interests of telling my "story", I have chosen to concentrate on only this side.

Chapter 7 then discusses the sustainable development imperative, once again describing its context and characteristics. Although sustainable development is still a fairly amorphous but integrative paradigm (Pierce, in press), I argue in this chapter that because of its integrative potential it offers the possibility for reconciliation between human activity and natural systems, both over the short and the long term.

Chapter 8 examines the restraining and driving forces for the implementation of sustainable development imperatives, looking at how some of the systemic restraining forces work against its implementation at the federal level. Without addressing barriers, any proposed framework(s) for governance would remain theoretical and naive. As well, I outline how this gridlock of interacting forces mitigates against "deep" institutional change within the Federal Government.

Given my central assumption that sustainable development imperatives demand federal leadership, I argue in Chapter 9 that this leadership will not ensue unless a framework based on the reconciliation of the three imperatives is implemented across governments at all levels. In the absence of an 'ordering' or organizing concept, efforts to coordinate natural resources policies have been largely ineffective or have been used as covers to impose or prevent one use over others (Caldwell 1970). Such a reconciling framework is critical for consistent and effective government leadership to other sectors of Canadian society, ultimately leading to new forms of governance. A guiding framework of principles for decision-making is proposed, developed with my co-researchers through the electronic collaborative inquiry (described in detail in the next chapter). This chapter concludes with a description of the institutional characteristics that support the implementation of sustainable development.

My experimental work in ecology over the past 25 years continued to reinforce my perception of ecological relationships as incredibly complex and invariably time and space (i.e., context) specific. It seemed that most studies, either by controlling or failing to take into account most of the variables, reached conclusions that were either so conditional that they were irrelevant or were distorted explanations. My approach in all of my studies was to try and put together the most feasible story—always a provisional story open to refutation or refinement.

(Hill 1996)

Sustainable development will not be realized in this country (or elsewhere), however, unless the centrality of social actors and their institutions is recognized. Since sustainability must be socially constructed, that is, social and economic arrangements must be made purposively and responsibly (Cernea 1994), a proposed framework for governance that acknowledges this is described in Chapter 10.

The following two chapters, Conclusions and Reflections, provide a summary of the work and my own struggles with personal reconciliation, as a result of the many losses in my life over the last three years, particularly the loss of my beloved only child, Daniel James Frazer, who knew so well the problems of existential loneliness.

> ***. . .the accumulation of quotes, excerpts and repetitions is also an effort to be "multi-voiced," to weave varied speaking voices together as opposed to putting forth a singular "authoritative" voice.***
> (Lather 1991, p. 9)

I have tried to tell "my story" as clearly and as simply as possible, aided by the inclusion of boxes containing pertinent statements throughout the text. In addition, much of my literature review is appended. Given the breadth of the issue and the scope of this dissertation, I have chosen to append this wealth of information for two reasons. First, to illustrate the depth and range of alternative thinking on sustainable development and its long history of systematically being ignored, and secondly, to keep my story clearly imbedded in the present, allowing the reader to go back and forth between the past and present contexts.

With respect to references, as agreed upon with my co-researchers, their main contributions or voices are directly quoted. When the boxes are a direct quote from an author, page numbers have been included. It is difficult, however, in this kind of an intense collaboration, to truly separate one's own learning from the interactions of others, so we influence and are influenced by one another and by our contexts.

As well, I have chosen to write in a full narrative format, rather than using numerous headings and sub-headings, so as not to disrupt the flow of the discourse, or the interplay of the contextual space between the boxes and the text. Hopefully, the narrative powerfully convinces the reader of the necessity for reconciliation and the central role of values in any framework for sustainable development that attempts to influence policy directions and create space in the federal system for new narratives and for policy alternatives.

There are always many ways to tell and read a story, and this thesis is designed to be read on multiple levels, through the interplay of boxes, text, margins and appendices. The reader can chose to read only the boxes, or to read only the text, or hopefully, to interactively go between the text and the boxes, so that each enriches and informs the other, so that centres and margins shift (Hooks 1984). They are not meant to be substitutes, but are complements. They are also a means to reconcile the emotional, with the intellect and the spiritual to one another. I have used most of the boxes to highlight the values and issues by quoting a diversity of knowledge.

My aim is to enlarge the boundaries of the text and the margins, thereby transcending the limits that both place upon each other. I believe that process and product are not separate from one another, but rather each is informed and influenced by the other. Thus, I have tried to mirror sustainable development in my choice of tools and techniques that form the foundation of this dissertation, a mapping of multi-level contextual space, where reconciliation of the ecological, social and economic imperatives become an emergent process, and

> . . .the discourse, not a closure but a trace in an endless passage that can only aspire to a temporary arrest, to a self-conscious drawing of a limit across the diverse possibilities of the world. As Gilles Deleuze puts it, sense is a surface-effect, an event, and not the sign or symptom of an absent origin, a lost totality, or a pure consciousness. It is precisely this lack of a fixed referent or stable foundation that produces meaning. For to produce it does not mean to touch a sacred stone or turn the right key that will reveal the nature of things, but involves tracing out a recognizable shape on the extensive complexity of the possible. Our interpretations of society, culture, history and our individual lives, hopes, dreams, passions and sensations, involve attempts to confer sense rather than to discover it.
>
> (Chambers 1990, p. 11)

2

Research Methodology

It is more important to be clear about and follow your "passion to inquire" than a "methodology", i.e., methodology must serve your passion and not your passion be subservient to a methodology.
(Hill 1997)

Just as there are many ways of viewing the world, so there are many ways of 'doing research'. Research methodology, however, is context-dependent, in that the issue being studied informs the choice of methodology, just as the choice of methodology influences research outcomes. The problem is not that any one research method is flawed, but rather, with the Enlightenment and positivist influence and its unshaken belief, until fundamentally challenged by post-modernism (Derrida 1984; Foucault 1986; Lyotard 1984; Rorty 1979; and Wolfe 1998), that there was an ultimate truth, and only one way of researching, the scientific methodology. Maruyama (1981) argues that the heterogenistic processes that increase differentiation in all sorts of biological and social processes, and that increase complexity, diversity, structure and the amount of information available, and that have enormous survival value for ecological systems, must be taken into account when designing and selecting research methodologies. Bateson (1979) similarly points out that an increment of knowledge may result from multiple versions of the world. For a more detailed description of basic beliefs concerning inquiry paradigms, please refer to Appendix B.

> ***There are many different ways of being in this world, many levels of awareness about alternative 'spaces' that we may occupy either permanently or temporarily, but the trouble is that we have few clear or shared ways of identifying these or of talking about them.***
>
> ***Once we allow ourselves to see that there are alternatives to traditional ways of thinking and being in that world, we may permit ourselves to search for, explore, and practice them. This is enormously difficult, since the principles of traditional logic are entwined with ordinary states of consciousness so that our 'mindscape' (Maruyama 1979, Appendix C) seems to represent the only possible world view.***
>
> (Rowan 1981, p. 114)

It has been important to me that my work mirrors, wherever possible, the changes that I experience and write and talk about. Consequently, both the process and product have to have equal integrity, as both are informed by and inform one another. My choice of methodology is, therefore, dependent on the overall context in which I am working, as well as the context of the particular domain under study, sustainable development. Critical to my thinking are new process models of continuous learning and action, processes capable of contributing to critical consciousness, collective action and common meaning (DeMello et al. 1994), and new processes for exposing the assumptions underlying our dominant paradigms. Another requirement is the acknowledgment of the value-laden nature of inquiry. All knowledge is influenced by the bias of the observer, even so-called facts are constructed within the context of our values; and knowledge is, therefore, perspectival and culture-bound (Habermas 1972; Gramsci 1971). Moreover, an investigator cannot fulfill research objectives without knowledge of the broad range of his or her own experience, imagination and intellect. I also believe that all forms of knowledge are important, not only propositional knowledge, but also practical knowledge and experiential knowledge (Heron 1996; Reason and Rowan 1981).

> ***Qualitative research is conducted through an intense and prolonged contact with a "field" or life situation. The researcher's role is to try and gain a "holistic" overview of the context under study: its logic, its arrangements, its explicit and implicit rules.***
>
> (Miles and Huberman 1985)

My orientation has been evolving, it has not been static, and has involved a range of human dynamics and interactions; a shift away from a world found "out there" - objective, knowable and factual; towards a "constructed" world in which knowledge is contested and partial, the interplay of language, power and meaning (Lather 1991, p. 86). Consequently, I designed a forum for reflexive practice in which a group of researchers were able to challenge themselves and one another to make sense of the world they are encountering and hopefully build shared constructs for positive social change.

As well, it was important to me that my experience and my research be integrated, hence, my concern with praxis, that is "theory both relevant to the world and nurtured by action in it, and an action component in its own theorizing process that grows out of practical political grounding" (Buker, forthcoming cited in Lather 1991, p. 11). Praxis-based research employs a radical reflexivity that recognizes the interdependence of method, theory and values (Mishler, 1984 cited in Lather 1991). This research requires new forms of reciprocity in the research process in which the goal of encouraging self-reflection and deeper understanding by the study participants is at least as important as generating empirically-grounded theoretical knowledge. Theory-building becomes a dialectical process. Through reciprocal reflexivity and critique, participants come to identify the certainties, false consciousness and critical insights through the co-construction of descriptive and analytical reports.

> ***Qualitative research is an interdisciplinary, transdisciplinary, and sometimes counter-disciplinary field. It crosscuts the humanities and the social and physical sciences. Its focus is multiparadigmatic and its practitioners are sensitive to the value of the multimethod approach. They are committed to the naturalistic perspective, and to the interpretative understanding of human experience. At the same time, the field is inherently political and shaped by multiple ethical and political positions.***
>
> (Denzin and Lincoln 1994, pp. 3-4)

My research is, therefore, qualitative (Appendix D), being based on new paradigm research, and a systems approach. New paradigm research differs from more traditional approaches in adopting a systems perspective, in its subjective/objective dimensions, its considerations of intuitive and sensual knowledge, how knowledge is generated, in how it deals with contradictions, in exposing paradigmatic thought or phenomenological mapping, in its cyclical approach, its heterogenistic epistemology, its different measures of validity, its methods of integrating inquiry and intervention through dialogue, and in its associated learning cycles and assumptions (Reason and Rowan 1981).

I believe that the nature of sustainable development and human systems demand a systems approach. A system is a bounded set of units and the relationships between them (Miller 1965), so that the behaviour of the parts is constrained by the state of other parts through feedback. Thus, the parts are connected in a pattern that is characteristic of the system (Bateson 1979). The systems view of organization and communication challenges traditional logic, replacing notions of energy with the concept of information, and notions of cause and effect with patterning, feedback and redundancy (Rowan 1981). Bateson (1972, p. 459) has pushed systems theory the farthest, suggesting that 'the elementary cybernetic system with its messages in circuit is, in fact, the simplest unit of mind.' He identifies six criteria of mind, and argues that the phenomena that we call thought, evolution, ecology, life, learning, and the like occur only in systems that satisfy these criteria (Bateson, 1976).

The Cartesian legacy lends us a subconscious framework, a set of intellectual pigeon-holes, into which we always try to "fit" new knowledge. Systems thinking is different because it is about the framework itself.

(Checkland 1981)

For the above reasons, I chose a variant of Soft Systems Methodology (SSM), and participatory action research (PAR), and a methodology that is interactive by moving iteratively between practice, critical theory (dialectical thinking) and collaborative inquiry (Appendix E). The former is based on a non-numerical soft systems approach (Checkland 1981; Checkland and Scholes 1990) that recognizes that there will always be many possible versions of the system to be engineered or improved, and that system boundaries and objectives can only ever be partly defined. The basic approach is to formulate several models that are as relevant as possible to the real-world situation, and use them by setting them against perceptions of the real world in a process of comparison. It is rare that a single model will suffice to explain the multiplicity of phenomena of interest. Each has its own explanatory strengths and weaknesses.

If we are going to intervene in human affairs, we need better ways of inquiring into our "systems" of myths and meaning which constitute what we mean by "culture".

(Schweder and Le Vine 1984)

Inherent to soft systems methodology are the concepts of *Weltanschauung* or worldview and holon (Koestler 1978). Meaning is attributed to human activity and attributions are meaningful in terms of a particular image of the world, which, in general, is taken for granted. The methodology teases out such world-images and examines their implications (Checkland 1981). The systems paradigm is concerned with wholes and their properties, indeed, the research methodology itself is regarded as a holon. SSM is concerned with both the natural and human spheres, and it is the interaction between the two that is of interest. In the comparison phase, my objective is to ensure that the potential changes be defined to meet two criteria: that they are both *desirable and feasible*— systematically desirable and organizationally feasible.

An action researcher has some vision of how society and organizations could be improved and she or he uses the research process to help influence the realization of this vision, based on the premise that knowledge without action is meaningless (Elden and Chisholm 1993). Action research uses an epistemological egalitarianism in method that aims for participant learning and meta-learning, not just the solution to a scientific and practical problem, a co-generative learning process (Elden and Levin 1991). Trist (1976) pushes the concept of action research further by arguing that action research needs to be extended to also include action research in planning. He regards planning as a collaborative undertaking between social actors and social scientists to achieve an active adaptation to complexity, interdependence, and uncertainty, these being the conditions that most characterize the emerging world environment. The problem addressed is social in nature and calls for a collective solution, otherwise there is not participatory exigency (Park et al. 1993).

> ***Action research may also be described as problem-solving, thus suggesting its usefulness as a model, a guide, or a paradigm. It may also be defined as the application of the scientific method of fact-finding and experimentation to practical problems requiring action solutions and involving the collaboration and cooperation of scientists, practitioners, and laypersons.***
> (French and Bell 1992)

The particular variant of action research I am using, collaborative inquiry, is a form of co-operative inquiry (Heron 1988 and 1996; Rowan 1976) in which all those involved in the research are co-researchers, whose thinking and judgment contribute to generating ideas and drawing ideas from the experience and who are also co-subjects, participating in the activity being researched. This method transcends the researcher-researched dualism. While co-operative inquiry emphasizes a cyclical dialectic of action and reflection, collaborative inquiry is concerned with the transformation of organizations and communities into collaborative, self-reflective communities of inquiry. Developed by Torbert (1981, 1987, 1991), it builds upon the work of Agyris and Schon's idea of action science (Agyris and Schone 1974;

> ***Our rigour lies in the constant attention to process; the awareness of the meta-dialogue occurring. The rigour lies in making meaning from the complexity of the interactions in focus group and process work.***
> (Kaufman 1995, p. 63)

1978; Schon 1983; and Agyris et al. 1985). As such it attempts to develop a consciousness in which action and reflection interpenetrate, it begins from the assumption that research and action are inextricably intertwined in practice. The process of action inquiry positions the practitioner right in the contradiction between deep engagement, participation and commitment to the moment, and simultaneous reflection, standing back and self-awareness (Reason 1994).

In addition, since the individual or organization require knowledge about the outside world, equally they require knowledge that directly affects purposes and practices as well, what Torbert (1981) refers to as intuitive and sensual knowledge. More importantly, an acting system requires sensual (or operational) awareness and suppleness if it is to succeed in effectively enacting new knowledge rather than in behaving either habitually or awkwardly. As well, since human ways of organizing are complex systems, valid knowledge of social situations is gained only as other actors collaborate in the inquiry, disclosing their being, testing their knowledge, discovering shared purposes, and producing preferred outcomes (Torbert 1981).

Kurt Lewin (1946) is generally credited with introducing the term "action research" as a way of generating knowledge about a social system while, at the same time, attempting to change it. At about the same time, Collier (1945) identified the need for developing an approach to general action-oriented knowledge to understand and improve American Indian affairs. A distinctive action research thrust also developed in parallel in Great Britain immediately after World War II (Wilson, Trist and Curle 1952; Trist and Murray 1990).

Collaborative inquiry is often grounded in dialectical thinking as a means of dealing with contradictions, and paradoxes. Dialectical theories are always looking for contradictions and paradoxes within people and situations as the main guide to what is going on and what is likely to happen on three levels: the interdependence of opposites, the interpenetration of opposites and the unity of opposites (Rowan 1981). Dialectic thinking informs us that any value we have, if held to in a one-sided way, will eventually be shown to be an illusion. Contradictions are never 'resolved', rather there is an ongoing movement between opposites as an inevitable part of the human condition:

> we can no longer talk about simple 'growth' as the basic need of the human being, for growth is always within a dialectical relationship in a dilemma which is never fully resolved.
>
> (May et al. 1974, p. 19)

The final aim of a dialectical interchange is to distill a consensus construction that is more informed and sophisticated than any of the predecessor constructions, including, of course, the etic construction of the investigator (Guba and Lincoln 1994).

Collaborative inquiry demands a high level of elegant simplicity (Hill 1996), and a degree of quiet, yet effective facilitation. It is a means for the researcher to interact with collaborators so that they contribute directly to hypothesis-making, to formulating final conclusions, and to what goes on in between (Heron 1981). Their contribution may be deep, in the sense that the subject is a co-researcher and contributes to creative thinking at all stages, or shallow, where the subject is kept thoroughly informed of the research propositions (Ibid). As well, because I am teasing out emergent thoughts and ideas, I am highly dependent on the quality of the individual co-researchers and the quality of the intellectual synergy that develops between the researcher and the co-researchers, as well as on our levels of commitment to and engagement with the research. Leadership must be exercised, but in these types of collaborative and emergent processes, it should be kept in the background and not foreground. It is based on attentive listening guided by an initial set of strategic questions (Peavey 1986) (Appendix F).

> ***If research is to be genuine human inquiry about things that matter, instead of something more limited, we have to be aware of all the questions which can be asked, even if we are not asking them ourselves.***
> (Rowan 1981, p. 105)

Strategic questions are an interesting tool for exposing dominant thought, methodologies and prevalent paradigms. Strategic questions, as defined by Peavey (Ibid), are questions that make a difference. They facilitate motion from stuck positions, create options and liberate creativity, dig deep exposing roots, avoid asking "why" or creating defensiveness, avoid simple questions that can be answered with only "yes" or "no", they empower versus manipulate, ask the unaskable and question assumptions, and they support expressions of our essence, our higher values and can therefore facilitate positive co-evolutionary change.

From my initial set of strategic questions, a sub-set of ordered questions (Appendix G) was selected to guide the collaborative inquiry and, in combination with conceptual models, they were used to help develop a guiding framework. Since dialogue can be a potent method of integrating inquiry and intervention, and can contribute to the intermingled processes of knowing and changing (Tandon 1981), the format for the preset inquiry was twofold, the email dialogue and the establishment of an archival website (http://www.sdri.ubc.ca/addialogue/). This particular venue was chosen because it satisfied the following four sustainability criteria. First, it saved on transportation costs, both economic and biophysical, by allowing participation from across the

> ***Dialogue has the potential to alter the meaning each individual holds and, by so doing, is capable of transforming the group, organization, and society. The relationship between the individual and the collective is reciprocal and is mediated through talk. People are both recipients of tacit assumptions and the creators of them. In this way dialogue results in the co-creation of meaning. The meaning that is created is shared across group members; a common understanding is developed.***
> (Dixon 1996, p. 24)

country, allowing for the factoring in of diverse geographical perspectives, in the most cost-effective way. Second, it eliminated unnecessary transcribing costs, as an electronic record is immediately produced. Third, it is democratic, as it allows for voices to be directly recorded as citations in the final products, the dissertation and submitted papers, and is more inclusive by removing the filter of the researcher from that being researched. Lastly, it addressed some aspects of equity, by considering factors of inclusion such as age, regional representativity, gender, and sectoral representation (with the exception of the business and labour communities). It cannot be denied, however, that our research group was comprised of elite, white, middle-class experts.

Selection of the participants (Appendix I provides biographical details of the co-researchers) was based on a modified Delphi approach, taking into account the above factors. Its composition was carefully designed to include policy analysts in strategic government positions and some non-government organizations as co-researchers in the formation of a common framework for governance, and who would therefore be committed to its implementation. Although the group included public policy practitioners, academics and community activists, it was decided that labour and business interests would have introduced too many variables, in that it was difficult enough to try and bridge the academic and government policy communities. As well, all of the individuals selected are committed to the concept of sustainable development, although there is considerable variation in their definition and meaning around that term, with many preferring sustainability to sustainable development. All of the individuals approached accepted to become participants in the dialogue, although the degree of commitment has varied considerably over time, with some members not participating at all.

Prior to starting the electronic collaborative inquiry in September 1997, I led two workshops to test the robustness of the models I had developed in my research proposal and that would form the foundation for the electronic inquiry. The first workshop was conducted at the Centre for Policy Alternatives in Oslo, Norway on December 14, 1995. On March 26, 1996, another workshop was held in Vancouver, with key members at the David Suzuki Foundation and the Vancouver ENGO community. Feedback from both workshops was very positive, that the models were a valid reflection of our current context. More importantly, however, they stimulated robust discussion, teasing out a subtext on values and dominant paradigms on a meta-level.

The electronic means of communication explode the space-time limits of messages, permit the surveillance of messages and actions, complete the process of automation of production, despatialize certain kinds of work, enable signifiers to float in relation to refer ads, become a substitute for certain forms of social relations, provide a new relation between author and text, expand infinitely human memory, and undermine the Cartesian ontology of subject and object.

(Postel 1987, p. 121)

Co-researchers were given a copy of the original research proposal, with its list of strategic questions, and preliminary models exposing dominant paradigmatic thinking and its influences. The first step was to establish a context of mutual trust, within which support and sharing of ideas could take place. The dialogue formally commenced in September 1996 and ended in September 1998, with 20 co-researchers from across Canada participating. A face-to-face workshop was held in Quebec at Lac Maskinonge, on June 27-28, 1997, which 10 co-researchers attended.

Understanding thus consists of circular and spiral relationships between whole and parts, between what is known and what is unknown, between the phenomenon itself and its wider context, between the knower and that which is known.
(Rowan 1981, p. 135)

The electronic medium allowed for continuous cycles of inward and outward contemplation, analysis, and reflection on the part of all participants, as depicted in Appendix H. The medium also allowed for alternating spirals of strategic questioning, critical reflection, action inquiry through the electronic dialogue, followed by information consolidation, and further rounds of critical reflection, strategic questioning and action inquiry through the peer review process, leading to a common framework for governance. My choice of research methodology allowed me to examine two levels, both the product, that is the eventual framework, and the process — was it possible to have a long-term substantive electronic dialogue?

At the end of August 1998, chapters dealing with the barriers, reconciliation and the proposed framework for governance were distributed to 26 key former and current senior policy practitioners in the Federal Government and quasi-government organizations (Appendix J) to obtain feedback and test the desirability and feasibility of the framework for governance. This was a limited form of peer review. Originally, I had intended to subject the feedback from the peer review process to another cycle of reflection with the co-researchers at a final face-to-face workshop, in order to further refine the framework. Due to funding and time constraints, however, this was not possible. While intended as a peer review, asking this key group of decision-makers within the federal system to critique a new model of governance for the future was also designed to influence their thinking and promote action around organizational change. In addition, the covert intent with the co-researchers was to create an intellectual coalition

According to this new model of inquiry, an acting system that does not engage in experiential self study can neither produce, nor collect valid data because of the unexamined incongruities within its experience. Such a system will both deliberately and unintentionally distort data and will resist processing feedback which identifies incongruities.
(Torbert 1981, p. 150)

In a dialogue, each person does not attempt to make common certain ideas or items of information that are already known to him. Rather, it may be said that the two people are making something in common, i.e., creating something new together.
(Bohm 1996, p. 2)

to support the necessary changes and to encourage future research in this area. Since most of the co-researchers have expressed an interest in continuing the electronic dialogue, the results of this peer review will continue to be discussed as part of an ongoing dialogue.

In some ways, the electronic collaborative inquiry is a form of extended interview survey, although it probes on multiple levels. It is designed to facilitate meaningful social action and change, both in the co-researchers as individuals, in the co-researchers as a collective group, and by influencing the systems under study through the peer review process. Of the 20 co-researchers, 5 were selected from the public policy sphere, 10 from the academic community and 5 from non-governmental organizations. In terms of regional representation, 4 from the West Coast, 2 from the Prairies, 1 from the East Coast, 11 from Ontario and Quebec, and 2 co-researchers were from Norway. With respect to gender balance, there were 11 women and 9 men; ages ranged from 23 years to 52, with a mean age of 32.

As a prelude to leading the electronic dialogue, I monitored a number of electronic discussions over a six month period prior to September 1997. The topics ranged from Gaia groups, animal rights groups, to a group on sustainable development, and a World Resource Institute forum. The medium allows for a large degree of anarchy, which can be both a positive and a negative, positive in the sense that it permits freedom of expression and thus is supportive of emergent thought, and negative in that consensus and collective action are more difficult to achieve. This anarchy contributes to an eclectic dialogue, but in all of the groups monitored to date, with the exception of one, the lowest common denominator was reached in a relatively short period of time. Conflict, particularly over values and very different paradigms, if not facilitated, contributes to this spiraling descent, and "flaming" is not an uncommon occurrence. Thus, lack of control is a major issue. In addition, the impersonal nature of the medium also works against building trust and collegiality, partly because it is less rich in social cues than face-to-face discourse (De Sanctis and Gallupe 1987).

The selection of the three sectors — public policy, academe and the non-governmental community (NGO) — was deliberately chosen to identify key or emerging leaders who would be committed to the process of framework development, and who would work as advocates for change in each of their respective domains. Participation was recorded as active, semi-active and inactive. Active was defined as continual engagement, electronic interaction with other collaborators, and showing a high degree of integration with respect to the dialogue. Semi-active was defined as less frequent engagement, although periodic, showing a high degree of interaction and synthesis within the dialogue. Inactive was defined as no participation, although there was a sense of active lurking, with only one person asking to officially withdraw from the dialogue, due to its overly academic nature. Out of the remaining sample of 19 co-researchers, with respect to the public policy experts, n=5, 1 could be characterized as active and 4 were inactive. It is interesting to note that this group showed the greatest degree of flux, perhaps symptomatic of the current downsizing taking place in the Federal Government and the associated lack of continuity and low morale problems. One co-researcher left government for the private sector, 1 is on extended sick leave, 1 experienced a marriage breakdown, 2 changed positions within government, and 1 remained in the same position. With respect to the academic community, n=10, 6 co-researchers could be described as active, 3 semi-active, and 1 inactive. The NGO community in some ways was the most disappointing, n=5, 2 were semi-active, and 3 were inactive. Thus, of the total, 7 were active, 5 were semi-active and 8 were inactive.

I cannot under-estimate the importance of effective facilitation and leadership in chairing such electronic collaborations. It took all of my management skills, paradoxically calling upon most of the interpersonal skills I have developed through my 22 years management experience and expertise in multistakeholder processes. Knowing when to prompt the group, and when to hold back in order to facilitate dialogue and commitment to the research process was critical. The 'silence' sometimes was deafening, and yet, as the chair, I often sensed active lurking and unexpressed interest. I found that a variety of communication styles seemed to facilitate motion, an alternating of professional and personal messages in my capacity as chair often eased "sticky or stuck" points. Although I previously knew everyone, I neglected to take into account the need for more interpersonal meetings. In hindsight, I would have scheduled the first face-to-face meeting after the first month of dialogue instead of mid-way through the process and, if adequate funding had been available, I would have held at least two other workshops, one half-way through the dialogue, and the other at the end, to facilitate the development of a more synthetic framework.

Another technique I employed was to ask one of my colleagues to play the role of "agent provocateur". Occasionally, when the dialogue appeared to be flagging or flat, he would come in with some provocative statements, in order to stimulate or at times re-activate discussion. Although I generally avoided going off-line in terms of the integrity of the process, upon occasion I did so, to remind people of their commitment to the collective research process, although this was relatively infrequent. One surprising feature was the tendency of a minority of the academic colleagues to go off line to make individual commentary, although in many cases, I was sent a blind copy of this off-line commentary. There would appear to be a gender dimension to off-line communication, although this is such a limited sample, it is not meaningful to

> ***Putting together a contribution to the dialogue is putting one's thoughts on display for public scrutiny, to a group of one's most knowledgeable and critical peers. Most academics would no more launch a half-baked missive to knowledgeable peers than would my mother serve a cake mix to my paternal grandmother.***
>
> (Brown, Email correspondence, May 19, 1977)

draw conclusions. It is not surprising, however, that this behaviour occured, given the academic culture, and its emphasis on individuality and individual research. Another surprising and unanticipated barrier to free-flowing engagement was, in the words of one academic co-researcher, "Given the level and quality of the other co-researchers, many of whom are in a position to hire me, there is a level of intimidation."

Ken Nickerson, General Manager of Microsoft Network, in a recent speech at the 1998 APEC Conference, stated how we react to the written word depends on whether we're reading if off paper or a computer screen, based on left-right brain theory. Studies show that text read off a piece of paper (where light bounces off the sheet into your eyes) dramatically affects the left hemisphere of the brain. However, when that same text is read off a computer screen (where the light is projected from behind), the right hemisphere is more affected.

At least five significant barriers to effective dialogue emerged: literacy, language, trust, inter-sectoral communication, and disciplinary structure. Literacy was a surprising factor, in that in two cases, where people had self-identified and asked to be part of the dialogue, they were inactive participants. In one case, I suspect the barrier may be an age variable, in that the person does not know how to type very well, a major impediment to interacting with a deep information-rich computer dialogue. In the other two cases, although both individuals are very literate verbally, I subsequently determined they do not have a high degree of written literacy. In terms of written literacy, another interesting phenomenon emerged, in that, academics place inordinate importance on the written word, and frequently, I exhorted the group to allow the spontaneity of the medium, rather than the primacy of the written word, to take over. This was one of the major "sticking" points, or causes of the silences, I believe, when we lost the immediacy of the medium, a critically important compensatory mechanism for the emergent spontaneity and synergy that often develops in face-to-face interaction.

What does dialogue require of people? Those who engage in dialogue must come to it with humility, love, faith, and hope—a formidable list of characteristics, but one that exemplifies a relational, rather than technical perspectives (Dixon 1996).

Freire (1970, pp. 77-78) envisioned dialogue as the creation and re-creation of meaning and saw creation an act of love. Love is at the same time the basis of dialogue and dialogue itself.

Language was another major barrier to participation, particularly between the three sectors. Many of the public policy practitioners found the level and tone of debate too academic, whereas the NGO co-researchers were intimidated by the jargon, resulting in one withdrawal from this sector. Even using the word sector shows the importance of language, as it is divisional, and connotes hard and demarcated differences between groups, and yet it is easy to use given its widespread acceptance. The culture of vertical stovepipes is very much a macro-problem, and communication between sectors appears problematic. The academic sector, as often reiterated by one of the co-researchers, has to simplify its language in order to communicate their work to the wider publics. Of course, this will require a major paradigm shift in the mistaken belief that complex language and intelligence are somehow causally linked. The ability to take complex concepts and communicate them in clear and simple language proved to be a relatively hard barrier to effective communication between the three sectors.

One of my assumptions going into this research was that the public policy practitioners would not be able to participate as meaningfully as other people, given the tendency of large bureaucracies to emphasize confidentiality and secrecy. I anticipated that their participation would at the most be inactive, or semi-active, which has proven to be the case. The confounding variable of significant variability of employment among the public service co-researchers in the limited sample makes this observation difficult to prove or disprove. In subsequent questioning, professional and personal reasons were cited as the rationale for their level of inactivity. More trust may have developed between the three sectors if more interpersonal workshops had been scheduled. Trust between participants becomes an even more critical feature of electronic dialogues, given the impersonality of the medium and its possible tendency to dehumanize. Trust between sectors is, therefore, even more problematic as the research results showed. Subsequent planning for other electronic forums should take this factor into account.

This group dialogue makes me think of the various interdisciplinary projects that I have been in or part of over the last few years. I think one of Ann's goals in gathering this particular group of people together was for us to share and build on our different knowledge bases and experiences. But one of the things I have learned about interdisciplinary research is just how important the process is. Each new interdisciplinary research team has to take the time to build trust around the table. This is time-consuming and requires significant commitment to repeated meetings, etc. It means more than just an intellectual knowledge of the disciplines of your collaborators, but a personal knowledge of who you are dealing with, their assumptions—and as Caterina [Geuer] says, their personal values.

(Massey, Electronic Dialogue, May 9, 1997)

On the other hand, the level of collegiality quickly gained in two days at the June 1997 workshop demonstrated that some degree of relationality had developed over the first year of the dialogue. One of the techniques used at the interpersonal workshop was to ask everyone to tell their personal story, which revealed some interesting commonalties among the group, and served to forge some common identities.

The validity measures I kept in mind for my research process are taken from Reason (1981): valid research rests above all on high-quality awareness on the part of the co-researchers; such high-quality awareness can only be maintained if the co-researchers engage in some systematic method of personal and interpersonal development; valid research cannot be conducted alone; the validity of research is much enhanced by the systematic use of feedback loops, and by going round the research cycle several times; valid research involves a subtle interplay between different forms of knowing, resulting in thick knowledge; contradiction can be used systematically; convergent and contextual validity can be used to enhance the validity of any particular piece of data, and the research can be replicated in some form.

All contributions from the co-researchers are duly footnoted, and in addition to the electronic record, an archival website has been established at http://www.sdri.ubc.ca/addialogue. It is still a work in progress and a keyword searching capability will be added in January, 1999, since a majority of co-researchers have asked to continue an on-going dialogue of some form, leading to possible "funded" research projects.

3

The Context
Paradigms, Myths and Metaphors

A doubling of human population size portends a more than doubling of human impacts because humanity has sequentially exploited the most accessible of its essential resources.
(Daily and Ehrlich 1996)

A common symbol often occurring in young children's drawing is the sun. Young children appear to have an innate sensitivity to their place in the world and the importance of their environment to their well-being. Mentally disturbed children often colour the sun black.

As we mature, however, our intuitive sense of our environment is influenced by our family, the education we receive, the neighbourhoods in which we grow up, our experiences with nature and other creatures, our culture and religion, and lastly, our experiences as adults. All of these influences, in turn, determine the nature of the lens we use to view the world around us and our sense of place in the world.

> *Briggs and Peat (1985) describe paradigms as like 'spectacles', which scientists put on. Once donned, the spectacles mediate and condition the scientists' worldview: they filter in some things and filter out others. The spectacles are made from particular theories (e.g. quantum theory, relativity), together with the presuppositions surrounding the theories. They constitute a lens through which scientists discover what is worthwhile studying about nature, an object of scientific study.*
> (Pepper 1996, p. 261)

The nature of our perceptual lens is strongly shaped and coloured by the prevailing paradigms of the times in which we live, not the least of which are religion and sex. A society can be characterized by the myths, metaphors and dominant paradigms its members use to make sense of the world in which they live and their place in that world. Myth lies at the basis of human society. That is because myths are general statements about the world and its parts, and in particular about nations and other in-groups, that are believed to be true and then they are acted upon whenever circumstances suggest or require common response. This is mankind's substitute for instinct. It is our unique and characteristic way of acting together. Mythology, therefore, can be defined as the unquestioned beliefs shared by a society or civilization about the purposes and ways of life that are right and natural and worth maintaining (Michael 1993). More importantly, modes of governing and the expectancies held by constituencies derive from the prevailing mythology.

"Paradigm, in its established usage is an accepted model or pattern . . . In a science, a paradigm is rarely an object for further articulation and specification under new or more stringent conditions . . . Paradigms gain their status because they are more successful than their competitors in solving a few problems that a group of practitioners has come to recognize as acute" (Kuhn 1962, p. 23). From this established usage, however, the term has broadened from the scientific definition to encompass a wider social definition. Capra (1991) defines a social paradigm as a constellation of concepts, values, as well as perceptions and practices, shared by a community that forms a particular vision of reality that is the basis for the way the community organizes itself. Henderson (1991, p. x), on the other hand, states "In spite of Thomas Kuhn's many cautions to me not to over-generalize or to use his definition of paradigm in a social context, I believe a paradigm is a pair of different spectacles which can reveal a new view of reality, allowing us to re-conceive our situation, re-frame old problems and find new pathways for evolutionary change".

Asking the "deep" questions is at the core of understanding paradigms for the questions we ask are powerful shapers of the world we "see".
(Maguire 1987)

Paradigms are the "logics" or "mental models" that underlie the missions, systems of governance, strategies, and organizational character and structures, including socio-technical systems, which are the parametres of the social architecture of institutions (Perlmutter and Trist 1986). Moreover, these worldviews have their place in the normative context of sustainable development problems; they are part of the social causes being unable to effect the necessary changes. They underlie the 'policy paradigms' of the normative observer, co-determining what comes to be seen as environmental problems and their appropriate solutions (de Groot 1992).

Myths and metaphors, therefore, complement and reinforce the overall dominant societal paradigms. A dominant myth in modern EuroAmerican thought is dualism, an "ism" that shapes the thickness, determines the colour, and the flexibility of the lens we use to understand the world in which we live. As well, it influences our relationships with other species and the sense of place to which we, as a species believe we are entitled. The Oxford Dictionary defines dualism as 1. being twofold; duality. 2. Philos. the theory that in any domain of reality there are two independent underlying principles, e.g., mind and matter, form and content 3. Theol. a. the theory that the forces of good and evil are equally balanced in the universe b. the theory of the dual (human and divine) personality of Christ.

Modern usage of duality is usually attributed to Descartes, in the 18th century. For Descartes, the pursuit of knowledge was the ultimate end, and therefore, the defining characteristic of human beings was the mind, and he saw mind and matter as fundamentally different. For Descartes, the material universe was a machine, and nothing but a machine. There was no purpose, life or spirituality in "matter". Nature worked according to mechanical laws, and everything in the material world could be explained in terms of the arrangement and movement of its parts. Since Descartes, this mechanical picture of nature became a central

Paradign literally means 'pattern' from the Greek root paradigma, meaning 'to show side by side.' Masterman (1920) illustrates three main meanings of paradigm in Kuhn's work: construct, sociological and metaphysical. The latter refers to the cultural values, beliefs about causality, reality and knowledge which are bound up with a worldview of Weltanschauuing.

plank within the paradigm of science (Capra 1982), at least until recently when some started to question it (Bormann and Kellert 1990; Funtowicz and Ravetz 1993; Hill 1993; Holling 1989/90; Jantsch 1980; Lee 1993; and Merchant 1980). But even though it was Descartes who led us to venerate dualism as the highest God, with his fundamental distinction between mental and material substance, he was simply reflecting a theme powerful in Western thought long before he wrote about it. A reliance on dualistic thought can be traced back to the Zorastrians, as well as to the Ancient Greeks and early Christians. Dualisms can be false dichotomies, that is, they are often constructed in order to maintain a power structure and a false conception of essential reality. They help set up systems of binary opposition that often become the bases of systems of dominance and subordination.

Regardless of its origins, dualism has been and continues to be an underlying value in Western societies' relation with the World, the tendency to separate into polar opposites of sacred and base; essential and existential; good and evil; and male and female with its loaded assumptions. Dualisms emphasize only extremes or caricatures of a continuum of existing entities or attributes. This, in turn, leads to an over-emphasis on opposites, disregarding the infinite range of possibilities in-between. The nondualist, by contrast is concerned with both unity and multiplicity. Yes and no are regarded as part of one systemic unified whole; and are concerned with an infinite multiplicity of degrees of affirmation and denial.

Following directly from dualism are the subsequent values placed on the mind versus the material, the dichotomy between the subjective and the objective, and the assignment of masculine and feminine attributes to one or the other. From the time of Plato and Aristotle, males were described as rational and objective; females as nurturing and subjective. As early as the nineteenth century, some feminists warned passionately about the dangers of such classification. As Claire Demare (19th century) exclaimed:

> You proclaim two natures! Indeed tomorrow, depending on how many declare themselves to belong to the one or the other, . . . You'll make one, perhaps involuntarily, predominate over the other; and soon we'll have a bad and a good nature, an original sin; . . . you shall be the God and I shall be the Devil.

Unlike most other feminists of the nineteenth century who venerated difference and argued for the value of two natures on the basis on morality, Demare feared the authoritarian dynamics of what she called the classifications, the subtle and metaphysical distinctions by which humanity divides itself into a series of orders, classes and types. Congruent with post-modernist theories on categories such as those of Lakoff (1987), Demare believed that classifications in and of themselves could be oppressive, and she saw real dangers for women in categorization. Dualism, complemented by the Judaeo-Christian movement of worship from the immanent to the transcendent, and the valuing of difference in male and female rather than emphasizing similarity, mutually reinforce one another.

The subject who excludes the other has been a white male subject and his exclusion of the other has been placed in the same logical class as the exclusion of 'not a': this meant that 'the other' was defined in terms of its own properties, but in purely negative terms.

(Brennan 1997, p. 189)

The myth that pervasively describes everything in the material world in terms of the arrangement and movement of its parts, and reduces nature to a linear mechanism has led to the making of numerous artificial separations. For humans do not perceive themselves to be energies only in deterministic mechanical relationships. Thus, if humans are not mere machines then perhaps there are other species that are also not mere machines? Indeed, the construction of any boundary between the fully machine-like and the not machine-like is a product of dualistic thinking. Another result of Cartesian philosophy is the separation of the heart from the mind (Head 1992). Furthermore, this separation has led to the decoupling of human society from its environment, a process of disembeddedness which has contributed to the destruction of nature (Rogers 1994).

" all the basic dualities – the alienation of the mind from the body; the alienation of the self from the objective world; the subjective retreat of the individual, alienated from the social community; the domination or rejection of nature by spirit – these all have roots in apocalyptic-Platonic religious heritage of classical Christianity. But the alienation of the masculine from the feminine is the primary sexual symbolism that sums up these alienations".

(Ruether 1979, p. 44)

One cannot underestimate the explicit, and more often subliminal, influence that dualism has played, and continues to play on intellectual thought and research, the design of organizational structures, gender relations, our interaction with the material world and our relations with other species. Until recently, many scientists maintained and rigourously defended the myth that researchers are objectively separate from their context or environment; the researcher and object under observation were regarded as context independent. Post-modern science, however, recognizes context as an important determinant of behaviours and beliefs. It acknowledges that no one can ever be separate from their context. Indeed they are an integral part of their context, and just as objects and subjects influence and interact with one another, so the environment also influences and interacts with all who observe and conduct research (Denzin and Lincoln

We now use about 2.5 million tons of synthetic pesticides worldwide each year, and pesticide production is a multi-billion dollar industry. Yet pests and spoilage still destroy about 25 to 50 percent of crops before and after harvest. That proportion, if anything, is higher than average crop losses before synthetic pesticides were widely introduced after World War II.

(Ehrlich and Ehrlich 1997)

1994; Guba 1990; Haraway 1991; Lather 1991; Miles and Huberman 1993; Reason 1993; Rosaldo 1989; Rowan 1991; Van Manen 1990).

Notions of objectivism, empirical realism, objective truth and essentialism have been deeply challenged by constructivists who argue that what we take to be objective knowledge and truth is the result of perspective. Knowledge and truth are human constructs. In human societies, knowledge is pluralistic and plastic, pluralistic because reality is expressible in a variety of symbol and language systems; plastic in the sense that reality is stretched and shaped to fit purposeful acts of intentional human agents. Thus, we invent concepts, models, and schemes to make sense of experience, and reality is the result of social processes accepted as normal in a specific context, and knowledge claims are intelligible and debatable only within a particular context or community (Fish 1988).

> ***Every structure is compelling. We humans, as human, exist as a network of structural couplings, that we continually weave through the permanent linguistic trophallaxis (the structural correlations that take place between organisms through exchange of food or secretions) of our behaviours. Language was never invented by anyone only to take in an outside world. Therefore it cannot be used as a tool to reveal the world. We work out our lives in a mutual linguistic coupling, not because language permits us to reveal ourselves but because we are constituted in language in a continuous becoming that we bring forth with other.***
>
> ***(Maturana and Varela 1987, p. 234)***

The dominant paradigms in our society exert considerable influences on how we structure our science, how we conduct our economic affairs, how we view our environment, how we build our settlements and how we organize our institutions of governance. Often, the dominant paradigm is implicitly imbedded in our daily decisions, how we receive or reject new information and most importantly, it shapes our receptivity to new ideas. It also affects our concept of what is worth striving for and what will or will not work (Brewer and de Leon 1983; Binswanger et al. 1990; Rees 1991).

The current prevalent socio-economic paradigm may be characterized by the following model, Figure 3.1:

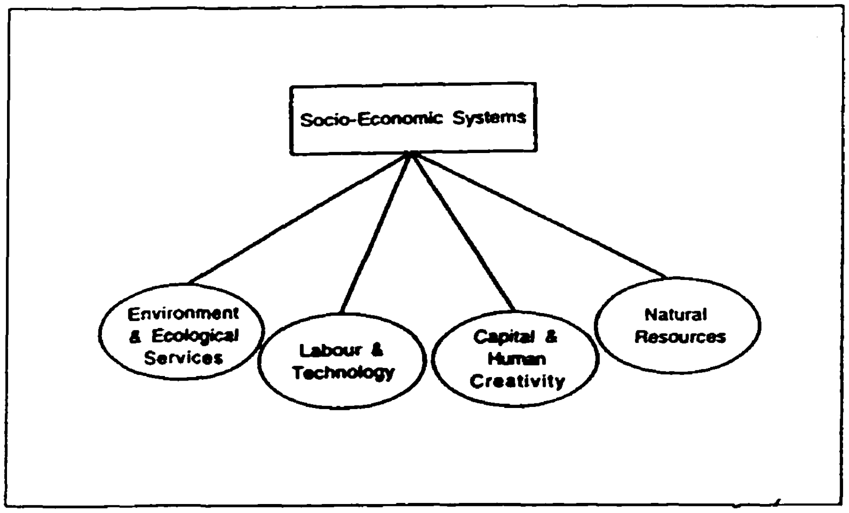


Figure 3.1 Prevailing socio-economic paradigm (adapted from Folke 1991)

In this exploitist model, the "environment" includes "nature", to which machine-like behaviour is often attributed. The paradigm of the well-oiled machine is reflected in the industrial philosophy of mass production (Taylor 1911), with workers considered as parts of the manufacturing machine (Morgan 1986; Smith 1776; Womack et al 1990). Fundamental characteristics of this model are its compartmentalization of complex systems and its reliance on models of direct, linear cause and effect. It leads to a hierarchic classically bureaucratic philosophy for both management and regulation (Burrell and Morgan 1979; Parsons 1947). What happens in the "separate" contextual environment is of secondary, if any, importance to whatever it is that is currently valued or not valued within that environment. Human systems are dominant over natural systems, and the latter exist as sources of resources and sinks for wastes, to support production and consumption within the socio-economic system. The environment and ecological services are taken for granted, are not valued and therefore are external to the market. Essentially, nature is seen as a free good and an unlimited factor of production. Natural resources are regarded as inexhaustible, or at least substitutable, with human creativity via technology or new discoveries. The socio-economic system is unconstrained by any biophysical limits, and if limits are acknowledged, they are regarded as transcendable by human innovation and technology (Lipsey 1995). Policies that derive from such models suffer from rigidity, over-simplification, lack of adaptability, resource exploitation aimed at maximum sustainable yields, inefficiency, incapacity to recognize negative feedback, with ecologically damaging and economically perverse outcomes (Holling 1978; Ludwig et al. 1993; MacNeill et al. 1991, and Merton 1936).

A utilist alternative to the above paradigm of nature as the "other" is given in Figure 3.2, a model being promoted by the International Institute for Sustainable Development (IISD). Although some kind of cybernetic interactions may be regarded as occurring between human

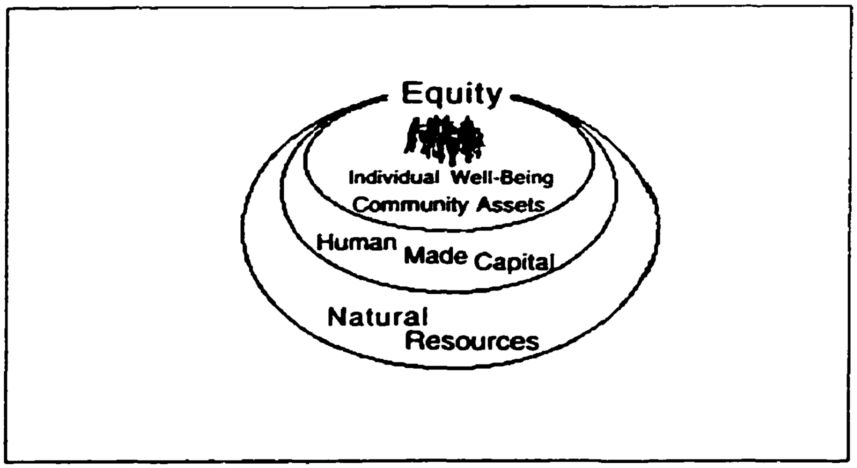


Figure 3.2 Alternative utilist model (International Institute for Sustainable Development)

and ecological systems, they are still perceived as inherently separate.

Each of these two worldviews has embedded within them implicit values and assumptions. The dominant "exploitist" model (Figure 3.1) assumes that growth is inherently good; there may be no limits to that growth, and if there are limits, they can be transcended by man's knowledge and technology. There is an infinite ability for substitution between human and natural capital. It is a model of dominance and hierarchy, which presumes the dominance of the human species over all others and an associated rights regime that subjugates the natural world. Its science can be characterized by the certainty of knowledge, and control over the natural world. It is reductionist, analytical, and curiosity-driven. Neutrality is revered for scientific rigor. Rigor is based on linear predictability and replicability, and its fundamental premise is duality, characterized by an either/or approach to explanation and research.

The concept of holism and holons has been proposed by a number of scholars. Smuts (1926) suggested that..."Behind the evolutionary movement and the holistic field of nature is the inner-shaping directive activity of Holism itself, working through the wholes and in the variations which creatively arise from them...these variations are not accidental or haphazard, but the controlled, regulated expression of the inner holistic development of organisms as wholes." Koestler (1978) states the concept of the holon is meant to supply the missing link between atomism and holism, and to supplant the dualistic way of thinking in terms of "parts" and "wholes" which is so deeply ingrained in our mental habits, by a multi-level, stratified approach. Jantsch (1980) proposes a paradigm of self-organization based on the interconnectedness of natural dynamics at all levels of evolving micro- and macrosystems. From such an interconnectedness of the human world with overall evolution springs a new sense of meaning.

The assumptions and values implicit in the alternative "utilist" model (Figure 3.2, currently under discussion in the Federal Government and quasi-government organizations, and referred to as ecosystem management) include the notion of some limits to growth imposed by the carrying capacity of the planet, as well as some recognition of responsibility by humans for other species. Although, by having the model kept open, it accepts that these limits are more plastic and that ultimately, human creativity may well find alternatives and substitutes to push the limits further. This responsibility, however, is primarily utilitarian, and there is a firm belief in the ability of human beings to manage the environment through ecosystem management. Policies underpinned by this paradigm still include conquest and control of what are now recognized as dynamic, interactive natural systems, and an adherence to the myths of one (right) point of view and the pursuit of stability. As well, policies are developed in a limited decision-making context with an emphasis on maximum sustained yields and the separation of human from natural systems.

An alternative integrist model, which I am proposing and which forms a central part of my research is depicted in Figure 3.3.

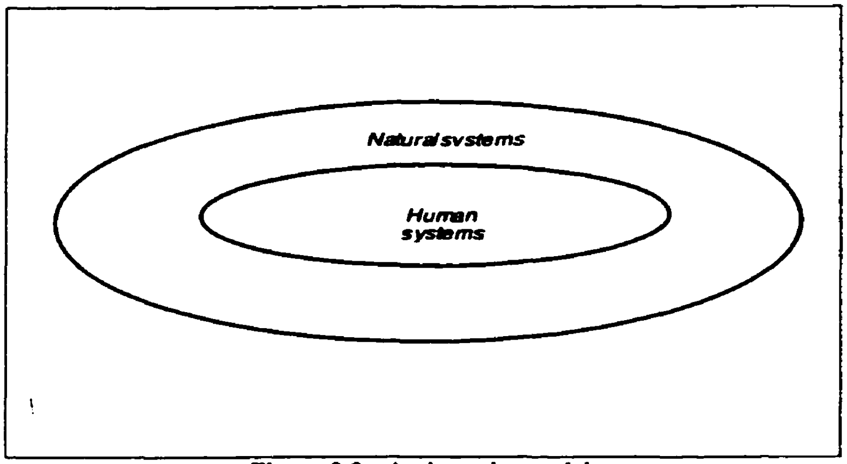


Figure 3.3. An integrist model

Within this third "integrist" paradigm, which can be characterized by both/and, there is a growing appreciation for qualitative versus quantitative growth, and natural and human resources are regarded as complements, not substitutes. Its science is characterized by systems that are seen as SOHO, an acronym coined by Arthur Koestler (1978), for Self-Organizing, Holarchic, Open systems.

In this paradigm, the global human system is seen as a "holon", or "whole-part" of reality, nested within a larger biosphere holon. Any holon with SOHO features has inherent within it a creative evolving capability. The holarchic model implies that there are absolute limits to growth imposed by the biosphere to which human systems are subject. Any holon persists because of reciprocal relationships between it and the other holons with which it interacts. For the human holon, the biospheric holon is indispensable. There is, therefore, an interdependence of human species with other species, and a different sense of "relationality" with the world. There is an emphasis on the co-evolving process between human and natural systems, with a value being placed on designing and managing human relationships with the environment, rather than managing the environment, or even managing impacts. Other values include integration, rather than separation, with a focus on reorganizing and valuing both commonalties and differences. It emphasizes a plurality of hierarchies that respond to a shifting network of natural constraints and interactive influences (Lincoln and Guba 1985; Morgan 1986, and Weick 1985). There is a notion of a much more extended peer community, than in traditional science (Funtowicz and Ravetz 1993; 1991).

...a society must be understood more as an ecosystem of processes (and the structures maintained by them). Such processes incorporate ways of conceiving the world in terms of which people define themselves and act purposefully, frequently develop according to dynamics which transcend and constrain the dialectical processes, and at the same time are processes within nature and must be understood in relation to geographical and ecological conditions of humanity. These processes are often in conflict with each other, and such conflict can eventually lead to the destruction of one process by another which is dependent upon it for its very existence. The concepts of conditional and immanent causation provide a means to understand and clarify such a multiplicity of relationships of partial dependence and autonomy, and often partial conflict, between the different human processes and between these and other natural processes.

(Gare 1995, pp. 135-156)

Because this model also embraces uncertainty and unpredictability -- because it places human activity systems within the finite biosphere -- it values longer-term perspectives and courses of action that ensure survival, satisfying optimal rather than maximum requirements. As such, a multi-faceted flow of information is needed to support adaptive flexibility at all levels of an organization or system (Sahl and Bernstein 1995). The ability and capacity of the human systems to respond to negative feedback is also critical to understanding the limits of the biosphere. Policy development, therefore, has to be a dynamic, interactive process, growing over time through a recursive process (Bateson 1979; Clark 1985; Swartz 1991; Weick 1985), with a greatly expanded decision-making context respective of the plurality of "stakes" in the issues.

The illusion that we can use technology to completely transcend time, place and scale constraints of the biophysical world, and that we can continually expand our ecological footprint well beyond finite physical boundaries, follows from the exploitist model (Figure 3.1). This illusion is underpinned by dualism and all of the subsequent separations it engenders. It is only a short step from Descartes' roots of radical separation of self and object, to the man-nature dichotomy, to separations based on gender, and of our species from "other" species. Our separation from nature, and making it "an other" leads to attitudes of dominance based on differ-

Biosphere is the widely used term for all of the earth's ecosystems operating on a global scale. The levels in the ecological hierarchy involve life and biological processes, so we can think of the biosphere as being that portion of the earth in which organisms and people can live; that is, soil, air, and water. The biosphere merges imperceptibly into the lithosphere (the rocks, sediments, mantle and the core of the earth), the hydrosphere (surface and ground water) and the atmosphere, the other major subdivision of the earth.

(Odum 1989)

ence. Our emphasis on difference leads to differential valuations of what constitutes good and bad, what constitutes integrity, and to polarities such as productive or non-productive, efficient or inefficient, and friend or enemy. Changing the way we view our environment, our place in that environment, and our sense of relatedness may be a crucial first step to changing the scope and type of our impacts in our individual communities, as nations, and globally, with a lens that focuses on "both/and" rather than exclusively "either/or". As we change our assumptions and associated definitions concerning what constitutes relatedness we are likely to challenge our existing ways of how we view nature and our relationship with it.

Ornstein and Ehrlich (1989) recognize the challenge that this presents us with, given the limitations of what they refer to as the old mind which evolved within a pre-modern habitat that is no longer the dominant environment for people living in industrial nations. Our capacity to create built environments and technological innovations, far exceeds our genetic and physiological ability to redesign our bodies and mind to deal with the consequences of our creations. Thus, there is now a mismatch between humans and the paradigms we have created. Our cultural responses are too slow to keep pace with the rapidity and degree of change (Toffler 1977) or, in many cases, to even perceive the reality of these changes before it is too late.

Early in a person's development certain perceptual rules are built in our genes and culture. Those rules help to shape the subjective world we inhabit. Most people remain unaware of the extent to which their worldviews are derived from their early experiences (Ornstein and Ehrlich 1989). Rules allow us to absorb a vast variety of information and stimuli and act as a filter for our responses. One of our most important rules or "defaults" is to ignore what is routine, and to respond quickly to sudden shifts, to emergencies, to scarcity, to the immediate and personal, to "news" (Ibid).

But, the increasing globalization of biophysical phenomena, coupled with the globalization of trade and with large scale movements of people, however, make responses non-linear, interactive and often unexpected in both space and time (Holling 1993). We, therefore, do not have the mental or physical capacity to even appreciate nor to respond to slower, interacting biophysical phenomena, that tend to manifest themselves to human activity systems only through accumulation of the co-evolution of human-nature systems. Although the human mental system has cleverly evolved cognitive strategies to steer us through the kinds of day-to-day conditions that challenged our ancestors, these same strategies, as well as our self-deception that we are largely rational thinkers, often underlie personal, social, and political problems (Ornstein and Ehrlich 1989). Claimed facts are generally the product of selective perceptions, beliefs, and interests, and these are always undergirded by feelings (Michael 1995). Demonstrably, the deep-seated ills of humanity and the all-pervasive crisis of our time are to a very large extent due to these inadequacies and the immaturity of contemporary thinking that underpins the values, motivations, behaviours and institutions that keep society lagging behind the realities of a changing world (Peccei 1978).

We are clearly living in a period of fluctuating myths. The positivist modernist myth claims that we can understand nature with science, control it with technology and create well-being by means of associated material abundance through the marketplace. We are now beginning to realize the naiveté of this, and witnessing the numerous unexpected negative side-effects (Norgaard 1994). The post-modern myth recognizes that systems are complex, interactive, co-evolving and to some extent self-organizing, and that they exhibit unique properties within different contexts. This myth builds on the insights of quantum mechanics, irreversible thermodynamics, information theory and organic evolution, as well as constructivism and pluralism, rather than the limited mechanistic insights of Descartes and Newton. Thus, our current array of critical unsolved problems, ranging from local toxic dumps to the disruption of global climate, is a product of the drastic mismatch between the cyclical and self-consistent processes of the biosphere and the linear, innovative, but ecologically disharmonious processes of the technosphere (Commoner 1992). What this implies for our species is that we must conduct our affairs such that we can conserve both our cultural and natural capital and facilitate their positive co-evolution by means of suitable institutional structures and processes.

The necessary changes will only occur, however, through transformation of civil societies into communities of knowledge. What is needed is a large-scale program for a rapid change of mind (Ornstein and Ehrlich 1989), and new forms of discourse. This will require changes in our educational systems, our values, our systems of governance and both private and public decision-making.

One of the greatest challenges, then, will be changing the dominant paradigms and prevailing mythologies, especially since the modes of governing and the expectancies held by constituencies derive from the prevailing mythology (Michael 1993). They can be challenged in at least five ways: first, by making these dominant ways of thinking explicit in every day discourse; second, by showing the influence and interaction between language and domination; third, by questioning the underlying values; fourth, by creating new narratives, myths and metaphors for social change; and fifth, by changing the boundaries of decision-making. Since mythologies are mostly unconscious social constructions of reality, the process of making them explicit exposes them to questioning and re-examination. The onus, therefore, is not always on those proposing "alternatives" to justify their viewpoints or to compete to be heard, but rather, on the dominant modes to re-examine and explain their patterns of thinking and action in the light of the current realities of the day.

Systems of governance will eventually have to change to acknowledge and support the notion of civil societies as communities of learning and knowledge. Their structures of signification, of legitimation and domination (Westley 1995) will have to fundamentally change. With respect to the latter, it can be argued that governments must move to take initiatives to strengthen communities, because highly centralized decision-making by national bureaucracies, multinational mining or logging corporations, and international resource management agencies are incapable of responding to, and, indeed, may actually suppress important local ecological feedback signals. Diffuse feedback processes in the natural world need to be matched by much more diffuse decision processes in human societies (Dryzek 1990).

These structures arise out of history and our own thinking. First there is the paradigm - the mind-set, from which it arises. Then there is the organizational structure which is built upon a certain world-view. If the mind-set is patriarchal, then the externally-imposed structure will tend towards the hierarchical. If the mind-set is that of community-building, then the structures put into place will tend to the co-operative or collective.

(Kaufman Hall 1995, p. 19)

Governments can play several key roles in the necessary reconstruction towards communities of knowledge. It means, however, abandoning their current forms of dominance and power, controlling and monitoring, and moving to a model of leading and catalyzing changes at the community level by encouraging strategic partnerships between government, non-governmental organizations and the private sector. Perhaps the distribution of reflexive capability (or impulse) is itself a contingent function of social relations of power (Wynne 1992). This will require the provision of analytical space for the development of policy alternatives and the creation of new narratives for social change. This requires the ability to acknowledge and accommodate diverse perspectives within a community (Boland and Tenkasi 1995), or a domain such as sustainable development.

Among the vehicles of narrative are articulated language, whether oral or written, pictures, still or moving, gestures, and an ordered mixture of all these substances; narrative is present in myth, legend, fables, tales, short stories, epics, history, tragedy, drame, comedy, pantomime, paintings, stained-glass windows, movies, local news, conversation.

(Prince 1982, p. 1)

Governments can play a key role in facilitating the necessary changes in the nature and quality of these discourses. It is important to expose and challenge the implicit assumptions and paradigms that underlie diverse arguments in order to allow for emergent change, or any necessary creative destruction. As well, using narrative modes of cognition provides access to implicit assumptions and interpretive structures that characterize a self-conscious learning society (Ibid). In order to challenge the old mind and its default mechanisms, governments must support the inclusion of continuous updates in the media concerning the slower processes that affect the human condition, as well as the provision of the information required to solve problems (Ornstein and Ehrlich 1989). In addition, strengthening the infrastructure within non-governmental organizations may be required to develop this capacity. It will require some sort of government partnership and leadership, however, as it is not within the self-interest of the many vested interests manifest in modern society to change the status quo. The capacity by governments to play this role is dependent on the existence of ethical and responsible leadership based on a framework of values, well-articulated and shared by a majority of its constituents.

Another artificial construct of our dualistic, rational, expert-driven model has been the exclusion of consideration of values from paid work and the conduct of scientific research. Values, however, are part of the human condition, and do, in fact, determine day-to-day decision-making. By re-integrating awareness of values back into human systems, we make them explicit, subject to debate and, therefore, allow for creative destruction and reorganization in response to current realities, rather than based on old mind, dominant historical paradigms, myths and metaphors that no longer apply to the real world as we have changed it. Values are central, therefore, either implicitly or explicitly to how we organize, how we see our place in the biosphere and the space we believe we are entitled to, our knowledge systems, and the technologies we design and use.

Another key role in encouraging the development of the needed new narratives for social change is fostering the production of useful knowledge and information that makes explicit the dominant myths and metaphors, and creating space for alternatives to be discussed. In particular, this will require that the influence of language on human beliefs and actions be exposed. For example, we need to be clear to what extent using the term 'living organism' rather than living beings allows us to continue using animals for experiments without questioning this largely unnecessary practice. As well, our dominant language is not matched to the reality of systemic interactions, circular feedback processes, nonlinearity, or to multiple causations and outcomes (Michael 1995). Increasing our awareness of the power of language is another important step towards exposing the often hidden influence of dominant paradigms.

I believe that just the act of exposing these dominant paradigms will act as a powerful catalyst for showing us the need for new ones. Coupled with the provision and use of pluralistic fora, this awareness will lead to the development of new perspectives and the emergence of myths and metaphors that can support a new appreciation of our role in the universe, our relationships with other species, and a new understanding about the value of diversity and beauty in our world, perhaps essentially leading to an acknowledgement that there is really no separate "other," and that we are all part of a still largely mysteriously integrated universe.

4

Ecological Imperatives

If I stand back and look as objectively as I can at the earth, what I see are populations made up predominantly of stressed, malfunctioning humans against a background of predominantly stressed, malfunctioning ecosystems.
(Hill 1981)

The health, well-being and ultimate survival of our own species is linked to and dependent on the health and sustainability of ecological systems (Ehrlich et al. 1977; Francis 1994; Holling 1986; Holling and Sanderson 1996; Ludwig et al. 1993; Odum 1989; 1969; Malley 1993; Wilson 1988; Walters and Maguire 1996). These systems provide the basic elements for life, ecological services such as fixation of solar energy; protection against harmful cosmic influences; regulation of the chemical composition of the atmosphere; operation of the hydrological cycle; water catchment and groundwater recharge; regulation of local and global climate and energy balance; formation of topsoil and maintenance of soil fertility; prevention of soil erosion and sediment control; food production by food webs; biomass production; storage and recycling of nutrients and organic matter; assimilation, storage, and recycling of waste; maintenance of habitats for migration and nursery; maintenance of the scenery of the landscape and recreational sites, and provision of historic, spiritual, religious, aesthetic, educational, and scientific information and cultural and artistic inspiration (Costanza and Folke 1996). The details of these essential biological services remain poorly understood in terms of their systemic processes, their interlocutory effects, and their co-evolutionary nature between human activity systems and natural systems. Most ecological services are unpriced and, there is a near total lack of public appreciation of societal dependence upon natural ecosystems (Daily et al. 1997; Mooney and Ehrlich 1997).

Their [educated people] inadvertent ignorance of the services that natural ecosystems supply to the human enterprise—of the reasons that the economy is a wholly owned subsidiary of those systems—amounts to a condemnation of schools, colleges, universities, and the print and electronic media. It also highlights the failure of professional ecologists to communicate their findings to the general public.
(Mooney and Ehrlich 1997. p.17)

What is the state of our current ecological capital? With respect to biological diversity, expert assessments vary greatly concerning the scale and temporality of the decline, although as early as 1980 it was predicted that 500,000 to 2 million species would become extinct worldwide by the year 2000 (Lovejoy 1980), and that the rate of decline would increase from 1 per day in 1970, to 1 per hour by the end of the century (Myers 1979). We may already be exceeding even these early estimates within tropical forests, which are estimated to contain over three-quarters of the species on the planet, and are now disappearing at the rate of 17 million hectares a year (WRI, IUCN and UNEP 1992). Estimates of potential species extinction in the tropics in general vary from 20 to 50 percent over the next 30 years. These species are predicted to either die out or be reduced to such small populations that extinction is inevitable (Dyers 1983; Ehrlich 1982; Lovejoy 1980; Simberloff 1983; Wilson 1985).

Losses of this magnitude are clearly undesirable (Ehrlich 1982; Kim 1993; Myers 1993; Reid and Miller 1989; Wilson 1988). Ehrlich et al. (1977) estimated that in the closing decades of the twentieth century the rate of species extinction will be some 40 to 400 times the rate that has prevailed through most of geological time. Much of this accelerating loss is occurring before we have had a chance to even name these taxa, much less to appreciate the unique services they provide within ecosystems. Because so few habitats have been adequately investigated, estimates of the total number of species on the planet vary by orders of magnitude from 3 million to over 30 million. In any event, only 1.4 million of these have been named and just a fraction of these have been studied in any detail (Wilson 1988). Our knowledge of most invertebrates, primitive plants and micro-organisms remains particularly fragmentary.

Three-fourths of the world's bird species are declining, and nearly one-fourth of the 4,600 species of mammals are now threatened with extinction (Brown et al. 1997). Radar images of flights of migratory birds across the Gulf of Mexico over a 20-year period reveal that the frequency of trans-Gulf flights has declined by almost 50 percent (Costanza and Folke 1996). In spite of the 1992 Convention on Biological Diversity, in two of the most important countries when it comes to biodiversity (Brazil and Indonesia), the loss of species has continued to increase. The pace of deforestation in the Amazon Basin, arguably the world's greatest single concentration of biodiversity, increased by 34 percent between 1991 and 1994. Indonesian wildlife is uniquely threatened, with little more than 1 percent of the earth's land area, it has roughly 12 percent of the world's mammals, 16 percent of reptiles and amphibians, and 17 percent of all birds. It is currently losing species at a rate of 1 a day, driven by a large and politically influential logging industry as well as a human population expanding by some 3 million people each year (Ibid). Loss of primary forest impacts on all components of biodiversity, but especially on our closest relatives, orangutans and great apes, who have lost 80 percent of their forest habitat in the last 20 years (Kuznik 1997).

Our ever expanding use of environmental goods, while ignoring the negative impacts on ecological services, has severe ramifications for the loss of biological diversity everywhere. Since our estimates of carrying capacity are dependent upon the value we place on the needs of other species within human systems, and the subsequent place we allow them, all

If we learn to measure our activities in terms of biodiversity impacts and if we reconceptualize our socioecosystem in a way that biodiversity losses are seen to matter to us as much as a shift in balance of trade or inflation rates, then we will begin to get signals back from the systems we are part of that will provide stabilizing feedback.

(Meredith, in press)

approaches to carrying capacity are species dependent. In general, human carrying capacity can be increased only at the expense of other species (Dale et al. 1995). The scale and nature of the resources and space that human activity systems appropriate, therefore, will determine the relative space and resources available for other species. Because of its irreversibility, the conservation of biodiversity is undoubtedly one of the most important issues now facing our society.

The rates of loss and degradation of terrestrial and aquatic habitats are continuing to increase and the existing mechanisms to ameliorate this are inadequate. The main cause of biodiversity loss is habitat destruction through resource exploitation, increasing population growth and technological expansion (Ehrlich 1988; Ehrlich and Wilson 1991; McNeely et al. 1990; Reid and Miller 1989; WRI et al. 1992). In 1993, 87 million extra people were added to the planet, bringing the world population to nearly 5.6 billion. The United Nations now projects that world population will not peak until after 2200, when it reaches over 11 billion (Brown et al. 1994).

But what is happening to the hundreds of non-commercial species taken incidentally or by poaching or ghost fishing by lost or abandoned gear. There is virtually no information.

One irreparable consequence of this wide-spread damage is the loss of the opportunity to study and understand intact communities. The damage is so pervasive that it may be impossible even to know or reconstruct the ecosystem. In fact, each succeeding generation of biologists has markedly different expectations of what is natural, because they study increasingly altered systems that bear less and less resemblance to the former, preexploitation versions.

(Dayton 1998, p. 821)

As our numbers increase, we inevitably displace other species. In the process of designing and managing human habitats, we also tend to create conditions in which pest and disease species, and species with requirements similar to our own, such as rats, cockroaches and houseflies, are favoured, and efforts to control them inevitably result in further negative effects. Even in those countries where burgeoning human numbers do not appear to be a problem, we are continuing to displace other species from the highest quality space through deforestation, agricultural expansion and intensification, and urbanization. Moreover, all of the world's great industrial cities are located on coasts, large estuaries, large rivers, or fertile deltas where the life-support capacity of the natural environment is high, and where we compete with other species for the same high quality space.

Every sustainable development issue, therefore, without exception, affects and is affected by biodiversity. Biodiversity may be viewed as a library of historical and emergent information, and as such provides not only a multiplicity of evolutionary and adaptive pathways for future development of life on earth, but the essential regenerative capacity for all living systems (Ehrlich 1988 and Regier 1994). Put simply, we need high biodiversity to ensure our own survival. Wilson (1985) estimates, for example, that the full information contained in the DNA of the common house mouse is equivalent to the text in the 15 editions of the Encyclopedia Britannica published since 1768, if the former were translated into ordinary printed letters. Schneider and Kay (1994, p. 36) have pushed this idea further. They describe the gene as:

> a record of successful self-organization. Given that living systems go through a constant cycle of birth, growth, death and renewal, at many temporal and spatial scales, a way of preserving information about what works and what doesn't so as to constrain the self-organization process is crucial for the continuance of life. This is the role of the gene. At the larger scale, it is the role of biodiversity.

Because certain species are known to play a keystone role within ecosystems, they especially ought to be conserved because they have a disproportionate effect on the persistence of all other species (Bond 1993). Such species include large predators that 'manage' competitor populations, mutualists such as pollinators and dispersers that facilitate reproduction, and nitrogen fixers and mycorrhizae that affect rates of nutrient transfer (Boucher 1985). As well as affecting the survival of other species, keystone species play a major role in maintaining community integrity and environmental quality. Thus, the loss of a keystone species will eventually lead to a multitude of linked extinctions, by means of a ripple effect that spreads throughout the ecosystem (Myers 1990).

> ***The lessons animals bring us as a community lie in our willingness first to acknowledge, then to question, our historic and current attitudes towards them. Why have certain animals been defined as "varmints"? Why have we collectively decided it is acceptable to kill nuisance animals? Why do we accept extinction for certain animals, yet protect others? If myths tell us that all predatory animals are cruel and merciless, how do we feel about ourselves, the supreme predators? Mythologist Joseph Campbell writes that as our old myths become outdated and stale in the passage of the ages, we must create new and viable myths to carry us forward. We need myths that can speak to our children of love, compassion, mercy and courage.***
> (McElroy 1997, p. 222)

With respect to ecological services, human activity systems are seriously impacting these critical life-sustaining processes. The thinning of the ozone layer is happening much faster than thought possible several years ago and, in addition, we are now beginning to appreciate that there may also be significant biological effects from ozone depletion. In response to the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer, global production of the most significant ozone-depleting substance, the chlorine containing chloroflucorocarbons (CFCs) was down 76 percent from its peak in 1988. Unfortunately, two alternative compounds, HCFCs and hydrofluorocarbons (HFCs), although the latter is ozone benign and the former significantly less so than CFCs, are both potent green house gases (Brown et al. 1997). According to projections by the International Panel on Climate Change (IPCC), annual HFC emissions could reach 148,000 tons by 2000 and 1.5 million tons by 2050, roughly equivalent in global warming impact to the current fossil fuel-based carbon emissions of France, Germany, Italy and the United Kingdom combined.

Each year, the chemical industry produces more than 100 million tons of organic chemicals representing some 70,000 different compounds, with about 1000 new ones being added annually (Postel 1987). Ultimately, a sustainable society may be one that minimizes its dependency on synthetic chemical production systems.

With respect to climate change, there has been a general upward trend in average annual global temperature, from about 14.5 degrees Celsius in 1866 to around 15.4 degrees in 1995, the warmest year on record. This trend correlates closely with an increase in atmospheric levels of heat-trapping greenhouse gases, principally carbon dioxide (CO_2). In spite of the 1992 Framework Convention on Climate Change signed in Rio, annual fossil-fuel related emissions of carbon rose by 113 million tons, reaching 6 billion tons in 1995. It now appears likely that over half the signatories to the Convention will not meet their commitments to cut their greenhouse gas emissions to their 1990 levels. By 1996, American carbon emissions were already 6 percent above the 1990 level, and without major new policy initiatives, can be expected to exceed 1990 levels by a full 11 percent. Moreover, carbon emissions have soared dramatically in developing countries in the first half of the nineties. In China, already the world's second largest carbon emitter, emissions grew at 5 percent a year in the early nineties, while economic growth averaged 10 percent. The International Energy Agency predicts that global emissions of carbon from fossil fuels will exceed 1990 levels by 17 percent in the year 2000 and 49 percent by 2010, when it is estimated to reach nearly 9 billion tons annually (Ibid). More importantly, there is a significant time delay in the reduction of emissions and effects on the atmosphere. For example, we would need an immediate decline of 68 percent in greenhouse gas emissions to cause atmospheric concentrations of these gases to stabilize by about 2050 (Robinson 1996).

Climate change is likely to overlap with various other pressures to cause problems far greater than would have been anticipated by the study of climate alone. In a destructive synergism such as this, several forces combine to produce a result far greater than the sum of their individual efforts. The potential for such overlaps is pervasive. UV exposure is increasing the most at higher latitudes—precisely where the greatest temperature changes are forecast. And air pollution is acidifying Eurasian boreal lakes as well as Canadian ones. Warmer temperatures are likely to increase acidification by speeding up the rate of soil decomposition, which will boost the concentration of acidic nitrogen compounds in rainwater runoff.

(Brown et al. 1997, p. 90)

Globally, cars are responsible for more than 15 percent of greenhouse gas emissions (National Resources Defense Council 1996), and yet we continue to produce more of the same technology. Global production of automobiles grew to 36.1 million in 1996, with the most dramatic increases occurring in Asia, where the fleet size rose 15 percent, to 19.5 million (Brown et. 1997). While human population has doubled since 1950, the number of cars has increased nearly tenfold (Ibid). If countries such as India and China adopt the car practices and habits of the North American consumer, then, this will have serious repercussions for global emissions. Unfortunately, any emission standards and increases in gasoline efficiencies are more than offset by the increase in car usage, as analysts project a doubling of the world fleet over the next 25 years.

In the early 1960s, most nations were self-sufficient in food: now only a few are, in spite of the Green Revolution (high-yield crops and energy intensive agriculture) introduced during the period 1950-1984. Twenty years ago, Africa produced food equal to what it consumed; today it produces only 80 percent of what it consumes (Cherfas 1990). Less than half of the world's land area is suitable for agriculture, including grazing (Lal 1990). Nearly all of the world's productive land, flat and with water, is already exploited (Kendall and Pimentel 1994). There has been a gradual decline in grainland area since 1981, with little or no growth in irrigation water supplies since 1990.

The human race now appears to be getting close to the limits of global food productive capacity based on present technologies (Ibid). Global population, at some 5.7 billion today, is projected to top 8 billion by the year 2020; nearly all the increase will occur in the developing world, where the constraints to increased production are even more exacerbated than in industrialized countries. Experts anticipate that over the next 25 years, food demand will increase by some 64 percent globally, and almost 100 percent in developing nations (Brown et al. 1996). They further estimate that with the world population at 5.5 billion, food production is adequate to feed 7 billion people a vegetarian diet, with ideal distribution and no grain feed to livestock (Ibid).

Pressures from growing populations are also straining water resources worldwide (Postel 1992). Globally, 214 rivers and lake basins, around which 40 percent of the world's population is located, now compete for water (Gleick 1993; WRI 1992-93). In China, ground water levels are falling much faster than the average recharge rate in major wheat and corn growing regions in the North (Postel 1992). More than 10 percent of world irrigated area appears to suffer from salt build-up serious enough to lower crop yields. There are strong arguments that the renewable resource most likely to perpetuate interstate resource wars is access to river water (Homer-Dixon 1993). Fisheries stocks are collapsing everywhere. Coho salmon is now extinct in 55 percent of its range, declining in 39 percent, and not considered to be declining in just 7 percent of its range. Of approximately 1,000 historic stocks, only 100 are considered somewhat healthy (Brown et al. 1997). Population and urban pressures continue to contribute to a decline in agricultural land (Meadows et al. 1992).

It is clear that the current decline in ecological capital, and the projected future rates of draw-down on natural capital and ecological services based on population figures, are not sustainable. Ecological systems provide the most critical infrastructure for humanity and all their activities (Behan-Pelletier, personal communication). The persistent and continuing, accelerated declining state of our ecological capital makes it obvious that we cannot continue to destroy the life supporting resources of the biosphere at the present rate and scale of modern human societies, if we accept the interdependence of our survival linked to its sustainability. Human activity systems are essentially a part of ecological systems. It is only our distorted worldviews that maintain the perception that we are separate. It may well be that if we look at what analogs in natural systems can be incorporated into redesigning human activity systems on the basis of the processes and functioning of ecological systems, then we may begin to reverse our decreasing ecological base, and, begin to restore degraded ecosystems.

Ecosystems are unique, often highly dynamic open systems characterized by complex, non-linear relationships between the parts and the whole. They exhibit self-organizing maintenance and regulatory and co-evolutionary processes, some of which may be fairly resilient and others highly susceptible to disruption by imposed stresses (Holling and Sanderson 1996). The task in working with ecosystems is to support these processes—thereby building negentropy—while knowing that our understanding of them is fragmentary and often inadequate to provide a solid foundation for wise decision-making. All species are the product of co-evolutionary processes, a few species being highly adaptable, but most being highly specialized, with narrow environmental requirements and tolerances. Appropriate decisions must be based on an understanding of this complexity; we must assign priorities understanding the implications of irreversible (biodiversity) versus reversible (economic) crises in mind.

Ecosystems are composed of communities, that are made up of definable and interdependent assemblages of populations of different species. These populations tend to be structured in chains and webs from producers, to primary, secondary and tertiary consumers, to scavengers to decomposers. Ecosystems are open systems, that is, things are constantly entering and leaving, and they are characterized by material and energy flows. These materials, which include carbon, phosphorous, oxygen and nitrogen, flow in cycles of varying complexity and scope. Energy flows through ecosystems according to the laws of thermodynamics. The first law states that energy may be transformed from one form (such as light) into another (such as food), but is never created or destroyed. The second law states that no process involving an energy transformation will occur unless there is a degradation of energy from a concentrated form (such as food or gasoline) into a dispersed form (such as heat and carbon dioxide). Known as entropy, it is a measure of disorder in terms of the amount of unavailable energy in a closed thermodynamic system. To survive and prosper, both natural and human systems require a continuous input of high-quality energy, storage capacity and the means to dissipate energy. These three attributes are part of the maximum power principle, that states that the systems most likely to survive in this competitive world are those that efficiently transform the most energy into useful work for themselves and for the surrounding systems with which they are linked for mutual benefit (Odum and Odum 1981). Successful systems also use these entropic processes to create order and mechanisms for maintenance, renewal and evolution (negentropy).

Fundamental characteristics of ecosystems are scale and limits, notions that apply equally to human activity systems (Commoner 1975; Leopold 1949; Meadows et al. 1992), although we may postpone the day of reckoning by taking from others, especially those yet to be born. As we move closer and closer to these limits, we are reducing our resilience, thereby limiting our options to respond to further stressors on both human and natural systems. Another integral part of ecosystem functioning is feedback loops that maintain a balance between inputs and outputs. In ecosystems, individual parts are as important as the whole, a type of dynamic connectedness. An ecosystem is a set of coherent evolving and interactive processes, an open system that co-evolves with its larger environment, just as human systems function as a part of the larger natural system, the biosphere.

Diversity enables a system to restore functions after a stress has been imposed because options are available. This is limited by the system's inertia, that is its ability to resist change, and resiliency, its capacity to absorb a certain amount of stress. Without functional diversity, all systems, both natural and human, become increasingly more rigid and less responsive to external signals over time, ultimately leading to total system collapse (Holling 1993). It appears to be a near universal truth that whereas functional diversity is the foundation of developmental progress within complex systems, uniformity (and dysfunctional diversity) leads to stagnation and decay (Korten 1995).

> ***The wisdom of many contributors to the Club of Rome reports, as well as the output of global models, conforms rather well to basic ecosystem theory, especially three paradigms: a holistic approach is necessary when dealing with complex systems; cooperation has greater survival value than competition when limits (resources or otherwise) are approached; orderly, sustainable development of human communities requires negative as well as positive feedback.***
>
> (Odum 1989, p. 262)

Ecosystems can also be described as self-determining, self-organizing and self-renewing; with a systemic interconnectedness over space and time of all natural processes; and by their openness and the creativity of their unpredictable evolution (Janstch 1980). They are dynamic living systems, where uncertainty and surprise are the norm. The beliefs of the 1970s, that for management purposes one can assume that ecosystems are stable, closed, and internally regulated and behave in a deterministic manner, are at last being replaced by a growing recognition that ecosystems are open, in a constant state of flux, usually without long-term stability, and affected by many factors outside of the system (Mangel et al. 1996). "Self- supporting" and "self-maintaining" are key terms characterizing the natural environment, which operates without energetic or even economic flows being fully controllable (Odum and Odum 1972).

Are there essential ecological principles, ways of organizing and processes that may prove to be important analogs for human activity systems to implement sustainable development? For example, is it important to be aware that young ecosystems are characterized by production, growth and quantity; and that mature ecosystems are characterized by protection, stability and quality (Odum 1969)?

Let's look at what happens as an ecosystem, of the autogenic, autotrophic type, moves through ecological succession (Table 4.1).

Table 4.1 Typical successional ecosystem changes

Ecosystem characteristic	Trend in ecological development early stage to climax or youth to maturity or growth stage to steady state
Community Structure	
Total biomass (B)	increases
Organic matter	increases
Energy Flow (Community Metabolism)	
Gross primary production (P)	increases during early phase of succession; little or no increase during secondary succession
Net community production (yield)	decreases
Community respiration (R)	increases
P/R ratio	P>R to P=R
P/B ratio	decreases
B/P and B/R ratios (biomass supported/unit energy)	increases
Connectedness	from linear food chains to complex food webs
Biogeochemical Cycles	
Mineral cycles	become more closed
Turnover time and storage of essential elements	increases
Role of detritus	increases
Nutrient conservation	increases
Natural Selection and Regulation	
Growth form	from r-selection (rapid growth) to K-selection (feedback control)
Quality of biotic components	increases
Niches	increasing specialization
Life cycles	length and complexity increases
Symbiosis (living together)	increasingly mutualistic
Entropy	decreases
Information	increases
Overall efficiency of energy and nutrient utilization	increases

This framework of successional theory may have important analogs for the future development of human society, since both natural ecosystems and human activity systems are complex adapative systems. For example, the species (or other component) matrix appears to adapt to the strength and variety of energy and material inputs. A dominant strategy within nature, then, is to diversify, but not to the extent of reducing energetic efficiency (Odum 1975). This principle of "maximum protection" (that is, trying to achieve maximum support of complex biomass structure) appears contrary to the current strategy of human beings, which usually emphasizes "maximum production" (trying to obtain the highest possible yield, often regardless of costs) (Odum 1969).

The relationship between gross production (P) and total community respiration (R) is important for understanding the total function of the ecosystem and predicting its resistance in the event of perturbation (outside forces). One kind of ecological "steady-state" exists when the annual production of organic matters equals total consumption (P/R=1) and if exports and imports of organic matter are either nonexistent or equal (Odum 1975).

When primary production and heterotrophic use are not equal, that is P/R is greater or less than 1, and when organic matter either accumulates or is depleted, then the community changes by a process of ecological succession. Succession may proceed toward a steady-state condition in which P equals R, either from an extremely autotrophic (producers) condition (P>R) or from an extremely heterotrophic condition (consumers) (P<R).

The rate of biomass energy production to rate of energy flow is another important property of ecosystems. Biomass and the standing crop of organic matter increase with succession. In both aquatic and terrestrial environments the total amount of living matter (biomass) and decomposing organic materials (detritus and humus) tend to increase with time. The larger the biomass (B), the larger the respiration (R), but if the biomass is large and the structure diverse and well ordered, the respiratory maintenance cost per unit of biomass can be decreased (Odum 1975). Whereas the strategy of natural systems seems to be to reduce the R/B ratio, our strategy has tended to the opposite, by harvesting as much as possible and leaving as little structure and diversity within the landscape as possible. It may well be that human activity systems should model their management and planning by mimicking as much as possible the characteristics of mature ecosystems, given the current interpenetration and interdependence of natural and human systems.

Holling's (1986) ecosystem model may provide another possible analog for the necessary reconciliation of maintenance (and regeneration) and production processes, and for the elimination of artificial separations that permeate our current institutional systems.

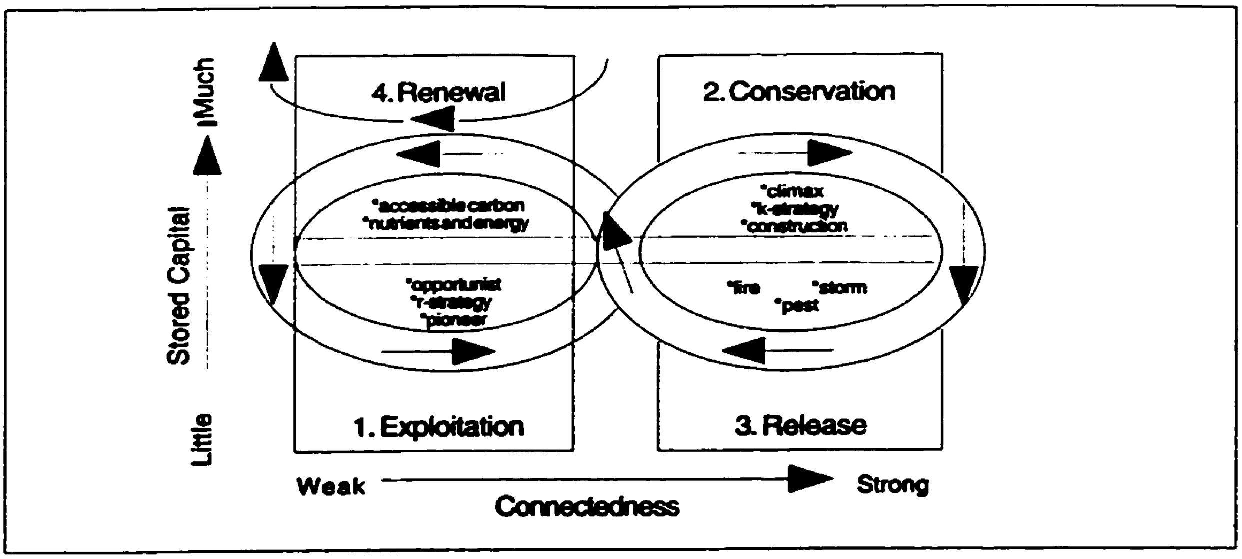


Figure 4.1. The four ecosystem functions (Holling 1986)

Holling proposes four basic phases that are common to all complex systems, and a spiraling evolutionary path through them. According to this model, systems evolve from the rapid colonization and exploitation phase (1), during which they capture easily accessible resources, to the conservation phase (2) of building and storing increasingly complex structures. Examples of the exploitation phase are early successional ecosystems colonizing disturbed sites and pioneer societies colonizing new territories. Examples of the conservation phase are climax ecosystems and large, mature bureaucracies.

The release that occurs within the "creative destruction" phase (3,4) involves the breakdown of mature structures via aperiodic events such as fire, storms, pests, or via political upheavals. The released structure is then available for reorganization and uptake in the next exploitation phase. The amount of ongoing creative destruction that takes place in a system is thus critical to its behaviour.

The conservation phase within bureaucracies often build elaborate and tightly bound structures by severely limiting creative destruction, but these structures predictably become increasingly brittle and susceptible to massive and widespread destruction. This is evident in the former Soviet Union and currently in (Phase 3) Canada, with the widespread federal/provincial gridlock. If some moderate level of release is allowed to occur on a more routine basis, the destruction occurs on a much smaller scale, through it's co-evolutionary renewal (Phase 4), and is able to support a more resilient system. It would appear that our current institutions are locked in a spiraling pattern of exploitation and conservation, and we have lost our capacity for release and renewal. We must now actively integrate these latter processes into government policy development and program design.

If we now turn to the human activity systems, as we have developed from hunting-gathering societies to our post-modern information age, and examine how our systems have evolved, we get a totally different scenario in modern day societies. In our short history, relative to other species, mankind has experienced a succession of growth states with ever-increasing levels of population density, resource and energy utilization, and environmental impact.

The real difference in these two classes of systems [human and natural] is in the distribution of the energy flow; man works to channel as much energy as possible into food he can immediately use, while nature tends to distribute the products of photosynthesis among many species and products and to store energy as a "hedge" against bad times.
(Odum 1975, p. 19)

Furthermore, none of the essential "public services of the global ecosystem" (Ehrlich et al. 1977) are currently valued by the dominant socio-economic system. No nation on the planet subtracts the costs of biotic impoverishment, soil erosion, poisons in the air or water, and resource depletion from gross national product. Rather, such impacts are paradoxically regarded positively. For example, the Exon Valdez oil spill off the coast of Alaska was reflected as an increase in our gross national product (GNP) because of the costs of labour and raw materials required to clean up the spill. Nowhere are the costs to the marine life, their loss and the long-term pollution reflected in national accounts. Nor can we even accurately assess their costs given the interactive effects and complex functioning of ecosystems.

There have been some preliminary attempts to put a value on these key ecological services. Constanza et al. (1997) have estimated that the current economic value of 17 ecosystem services for 16 biomes is in the range of US $16-54 trillion per year, with an average of US $33 trillion per year. Global gross national product is around US $18 trillion a year. Pimental (1996) estimates that whereas the value of over-the-counter, plant-based drugs is $84 billion annually, ecotourism is $500 billion.

Thus, there is a fundamental imbalance in both the way we record our financial affairs and the way we think about what is valuable. Valuation involves resolving fundamental philosophical issues (such as the underlying bases for value), being aware of the context, and the defining of objectives and preferences, all of which are inherently uncertain (Daily et al. 1997). This quantification becomes even more problematic with ecological systems, because ecosystem-level experiments are difficult to conduct, the outcome can be costly, and they need to be pursued over long periods of time (Carpenter et al. 1995).

It must be recognized, however, that not all of nature can be quantified. For, how does one assess the loss of the common loon to Canadian society? This involves, in addition to traditional valuation, complex aesthetic, spiritual and ethical considerations as well. What value do polar bears have to Canadians? How will our society be affected by their disappearance or decline? Do we consider that we would be worse off or are we indifferent to whether they become extinct? Do we save only the attractive birds and mammals, or do we consider the trade-offs between those species that provide critical keystone functions essential for the maintenance of ecosystems? There are no easy answers to any of these kinds of questions.

It is important to realise, therefore, that although economic valuation of ecological services and benefits must be confined to use values, the sometimes larger qualitative values simply cannot be measured; and that these values are based in both use and non-use. Use value includes direct value (e.g., harvesting for food), indirect value (e.g., contributing genetic diversity), and option value (e.g., the potential for future contribution). Non-use value derives from a resource's existence and intrinsic value for aesthetic pleasure, a bequest to future generations, and as a contributor to the general feeling about the environment (Norton 1987; Pearce and Turner 1990; and Pearce 1993). We cannot afford to wait for such valuations to be performed before initiating programs of conservation, rehabilitation and policy reform.

> ***Ecologism makes the Earth as a physical object the foundation-stone of its intellectual edifice, arguing that its finitude is the basic reason why infinite population and economic growth are impossible and why, consequently, profound changes in our social and political behaviour need to take place.***
>
> (Dobson 1990, p. 15)

The failure of modern human activity systems to understand, value and take into account this critical ecological capital has resulted in a significant decline in our natural assets, and the ability of the earth's ecosystems to continually absorb the impacts of human activities. In terms of the scale of all human endeavours — our population size, our waste products, our use of renewable and non-renewable resources; our economic practices and most importantly, our appropriation of the net primary productivity of the biosphere, we are now clearly approaching critical thresholds.

Ecosystem structures, functions and processes are primarily concerned with the maintainance of systems, whereas human systems are mainly concerned with production with little or no attention paid to maintenance (Hill 1998). We have been far more efficient in designing incentives to capture the flow of ecosystem goods than in protecting either the capital stock or the flow of ecosystem services (Hanna and Jentoft 1996). An important feature of ecosystems is that they are for the most part sustainable and self-organizing, and there is virtually no waste. It would appear, therefore, prudent for human activity systems to look at reconciling methods of production with an equal emphasis on the rehabilitaion and maintenance of ecosystems that provide the essential services for all life, including our own. We need a common language and an adequate conceptual framework within which to work (Constanza and Folke 1996), and institutional reform based on a convergence of human and natural system cycles (Holling and Sanderson 1996), and an emphasis on fundamental system design

While writing this chapter in the summer of 1997, a golden retriever puppy died in the Ottawa market area, while locked in a car with the windows rolled up in over 30 degrees. About 20 concerned bystanders stood helplessly watching, while waiting for the humane society officer to arrive, who unfortunately was caught in traffic. If it had been a child inside the car visibly suffocating to death, would the bystanders have hesitated to break the windows?

rather than the usual focus or narrowly conceived efficiency and changes involving merely substitution (Hill 1998).

In Appendix K, I have explained in greater detail some of the ecological terms used in this chapter. In Appendix L I have illustrated some of the many "alternative" paradigms for restoring balance between human activity systems and natural systems, including two Charters of Rights for the Environment. As well, I examine in greater detail some competing views about nature and man's environment in Appendix M. Although not comprehensive, it is meant to illustrate the cumulative thinking over time about these issues. We have had ample warning from a wide variety of experts since the beginning of the 20th century, and a history of boom and bust resource cycles. One has to ask the question why they have not had more debate on the mainstream agenda.

Avoiding these cycles will depend upon recognizing key ecological imperatives and proactively acting upon them. Five key ecological imperatives that I believe are necessary for human activity systems to realize sustainable development imperatives are: movement away from r- to k-strategy behaviour worldwide; redesign of all human production systems to produce virtually no waste; societal determination of the appropriate scale of human activity systems relative to the maintenance (and enhancement) of ecological systems; maintenance of functional biological diversity worldwide, and reduction of human-induced impacts on climate change.

5

Social Imperatives

Complex societies in fast-changing environments give rise to sets or systems of problems (meta-problems) rather than discrete problems. These are beyond the capacity of single organizations to meet. Inter-organizational collaboration is required by groups of organizations at what is called the "domain" level.
(Trist, 1983, p. 269)

The preceding chapter has shown how seriously ecological capital is declining for many reasons. Social capital is dependent upon ecological capital, just as it is also dependent on economic capital. All countries now face enormous social pressures from the interactive effects of over-population and associated environmental degradation, both of which are linked to and underpinned by poverty and inequity. A quarter of the world's people remain in severe poverty in a global economy of $25 trillion (Human Development Report (HDR) 1997). An estimated 1.3 billion people survive on less than the equivalent of $1 a day. Well over a billion lack access to safe water. And nearly a third of the people in the least developed countries—most of which are in Sub-Saharan Africa—are not expected to live to age 40. Half a million women die each year in childbirth—at rates 10-100 times those in industrial countries. Worldwide, women face the worst threats of violence. It is estimated that a third of married women in developing countries are battered by their husbands during their lifetime (HDR 1997).

World population grew from about 200 million people at the time of Christ to about 500 million by the mid 17th-century. It doubled to one billion by the mid 19th-century, with another doubling, to two billion by 1930. It now currently stands at over 6 billion. Hern (1990) has characterized this growth as a planetary ecopathological process.

Developed countries, despite their greater material well-being, face poverty of a different kind. Rising unemployment, declining disposable income and cuts in social services are driving many people into poverty, and some from relative poverty to absolute poverty. In the midst of increasing wealth among the upper classes of the North, hundreds of thousands of people are without housing on any given day, and several million are so poor and vulnerable that homelessness is a daily threat (Erikson 1994). In industrialized countries more than 100 million people live below the poverty line, which is set at half the individual median income; and 37 million people are jobless (HDR 1997).

In addition, poverty among the elderly and children has increased dramatically. In Australia, the United Kingdom and the United States more than 20 percent of the aged are income poor. One in every four children in the United States is income-poor—one in six in

Australia, Canada and the United States. In the United States every year nearly 3 million children are reported to be victims of abuse and neglect. About 75 million children aged 10 to 14 in developing countries—45 million of them in Asia, 24 million in Africa—are often working in slavery, prostitution and hazardous conditions. Each year, an estimated 1 million children, mostly girls in Asia, are forced into prostitution (HDR 1997). In Canada, although 20 percent of Canadians aged 16 and older are at the highest levels of literacy scales, 22 percent have very limited literacy skills and an additional 26 percent have some difficulty reading and writing (Government of Canada 1997).

In the past year, the Human Development Index, a measure created by the United Nations Development Program to gauge the degree by which people have available to them the resources needed to attain a decent standard of living, has declined in 30 countries, more than in any year since the Human Development Report was first issued in 1990. Meanwhile, in many of these countries gross domestic product (GDP) continues to grow. The perversity is that this measurement, which is currently used to define "progress", is a more accurate indicator of social decay. Indeed, primary indicators of social decline, such as crime, divorce, and mass-media addiction, actually increase the GDP. Divorce, for example, makes a significant contribution through professional legal bills, the establishment of second households, and increased transportation costs, therapy and counseling. Similarly, crime positively adds to the GDP through a growing crime-prevention and security industry with revenues of more than $65 billion a year (Cobb et al. 1995). A similar perversity happens with respect to resources and the environment. The more a nation depletes its natural resources and degrades its environment, the more the GDP increases. This violates basic accounting principles, as it portrays the depletion of capital as current income. Most pollution, for example, shows up twice as a gain. Toxic chemicals, for example, once when the factory produces them and liberates them into the environment, and again when the nation spends billions of dollars to clean up the resultant toxic site (Ibid 1995).

The increasing globalization of the world's economies are having negative effects on civil societies everywhere. Many communities are facing profound social disruptions as they struggle to diversify in this post-NAFTA, post-industrial age. There is an accelerating economic interdependence, decreasing national sovereignty, with the emergence of a truly global set of corporations and financial institutions and increasing pressure to maintain international competitiveness. As well, there are pressures to reduce public sector spending in industrialized nations, including spending on social programs, coupled with growing problems of structural unemployment in many industrialized economies. There is growing international debt with the resultant imposition of International Monetary Fund (IMF) structural adjustment policies in developing country economies.

Concurrent with this globalization, three particularly disturbing trends are emerging. First, there appears to be increasing income disparities, both among and within countries, coupled with rising levels of absolute poverty. A review of global economic growth since the mid-century shows growth peaking during the sixties at an annual rate of 5.2 percent, thereafter dropping in each of the next two decades (Brown 1995). There is much debate about whether these two effects are made worse or better by this trend toward global economic integration (Henderson 1991; Rees and Wackernagel 1994; Waring 1995), but regardless of one's views, it is clear that current socio-economic conditions are unsustainable for a large and growing proportion of the world's population in both so-called developed and developing countries. Although the ratio of global trade to GDP has been rising over the past decade, it has been falling for 44 developing countries, with combined populations of more than a billion people. The least developed countries, with 10 percent of the world's people, have only 0.3 percent of world trade, half their share of two decades ago (Brown 1995).

Second, there is a world-wide trend toward the increasing feminization of poverty and women's continuing social exclusion. Although women make up just over half of the world's population (50.4 % in Canada) and contribute to over two-thirds of all the labour hours worked by the human race, they are disproportionately poor.

Estimates indicate that women are the sole breadwinners in one-fourth to one-third of the world's households; and at least one-fourth of all other households rely on female earnings for more than 50 percent of total income. In Canada, in 1993, 56 percent of all people below the poverty line were women. This increased to 72 percent among those over age 65. Children bear the brunt of women's economic inequality. Of the 601,000 children in Canadian single-parent families headed by women in 1993, 65 percent were below the poverty line, compared to 18 percent of all children in two-parent families. Clearly, gender bias contributes to the increasing feminization of poverty globally; in its various forms it prevents hundreds of millions of women from obtaining the education, training, health services, child care, and legal status needed to escape from persistent poverty.

> *No nation, however rich in physical resources, can afford to sideline half its human potential, but this is effectively what we are seeing in nation after nation, rich and poor.*
> (Sharon Capeling-Alakija, Miami, 1992)

About one in five Canadian children — more than 1.4 million — live in poverty. Studies show that poor children are more likely to lead a life of poor health, poor education, trouble with the law, and dead-end jobs. Thus, children born into poverty usually remain in poverty the whole of their lives, perpetuating a continual cycle of winners and losers, clearly an unsustainable pathway over the long term. A society that tolerates 20 percent of its children growing up in poverty is not a healthy society. This, in turn, leads to a rotten economy

(Paul Martin, January 10, 1997), and increasing unsustainability.

Despite the importance of women's role in society and the advances they have made toward securing equality, according to the Human Development Index (HDI), women have lagged behind men in every country for which data are available (1992).

In 1995, the United Nations made gender analysis integral to the overall annual reporting process, by adding two measures: Gender Development Index (GDI) and Gender Empowerment Index (GEM). The latter measures the extent to which women and men are able to actively participate in economic and political life and take part in decision-making. It is clear that although the pace of development has been robust, it has been accompanied by rising gender related disparities both within and between nations. Women still constitute 70 percent of the world's poor and two-thirds of the world's illiterates. They occupy only 14 percent of managerial and administrative jobs, 10 percent of Parliamentary seats and 6 percent of Cabinet positions in Canada.

Gender analysis is based on the belief that policy cannot be separated from the social context, and that social issues are an integral part of economic issues. Social impact analysis, including gender analysis is not just an "add-on", to be considered after costs and benefits have been assessed, but an integral part of good policy analysis.

Ultimately, the continued exclusion of women from ecological, economic and social opportunities is not sustainable. If sustainable development, through the reconciliation of all three imperatives, is to be realized, both short- and long-term equitable access to the fundamentals of life by women as well as by men would appear to be a basic precondition.

Gender inequity is particularly significant in certain sectors. For example, women represent only 17 percent of Canadian university faculty and continue to be significantly under-represented in disciplines with direct environmental significance, such as ecology, biology, economics and geography. In corporate decision making, only 2 percent of chief executive officers in Canada, and 2 to 3 percent of top American executives, are women. This under-representation of women in positions of sustainable development decision-making and in the primary sector labour force, ensures that women's concerns are likely to be neglected when generating and implementing sustainable development policy. The participation of women in environmental industries, and in businesses promoting Agenda 21, is poor; almost 90 percent of employees in environmental industries are male (MacDonald 1995).

In promoting sustainable development, we are in fact talking about upgrading the value of feminist "values", both in men and women. A dualistic approach will never do — the "balance" in the middle does not exist as a solution, that would be stagnation. The human dimension in sustainable development is, according to a non-dualistic approach, to make spirit and matter meet. In order to do that, we have to develop as a whole (bi- or non-polar as opposed to uni-polar), independent, conscious and responsible individuals. It requires that we move from gendered men and women to men that accept the feminine dimensions within themselves, and women that also accept their masculine dimensions.

(Eie, Electronic Dialogue, January 21, 1997)

Because strengthening the power of women to choose and act is congruent with reconciling the three imperatives, it is an essential condition for the achievement of sustainable development. For example, a recent study conducted in four countries in Africa by the World Bank showed that a 15 percent increase in food production could be achieved, without consuming more resources, if women had better access to land, production inputs (credit, fertilizer, and improved seed) and markets. Additional data from the World Bank (1997) indicates that if the education of girls and women had been raised 30 years ago to the level that boys and men then enjoyed, fertility levels today would be nearing the target of global population stabilization. Furthermore, household welfare among the poorest would be higher and local management of natural resources less problematic.

> ***Gender equality means that women and men have equal conditions for realizing their full human rights and potential, and for contributing to national political, economic, social and cultural development and benefit equally from the results. Equality is essential for human development and peace.***
>
> ***Attaining gender equality demands a recognition that current social, economic, cultural and political systems are gendered; that women's unpaid status is systemic; that this pattern is further affected by race, ethnicity and disability; and that it is necessary to incorporate women's perspectives, priorities and values into all major social institutions.***
>
> (Canadian Federal Plan for Gender Equality 1995, p. 10)

The social costs of gender inequity and exclusion from decision-making—of societies divided into winners and losers—must be addressed if we are to achieve sustainable societies (Geuer and Knight 1995). Indeed, gender equality may well be the most important tool for the more rapid diffusion of sustainable development practices, policies and programs throughout society.

A third global trend is the rising concentration of income, both within and between countries. The ratio of the income of the top 20 percent to that of the poorest 20 percent rose from 30 to 1 in 1960, to 61 to 1 in 1991—and to a startling new high of 78 to 1 in 1994 (HDR 1997). This income disparity gap has been increasing in spite of structural adjustment programs and financial assistance from the international monetary agencies. Income disparities are also rising within developed nations, paradoxically as wealth increases, it is becoming more and more concentrated. In 1994, in 29 of the 68 developing countries for which data were available, the ratio of incomes of the richest 20 percent to those of the poorest 20 percent was over 10 to 1; in 16 countries, 15 to 1; and in 9 countries, 20 to 1 (HDR 1997). During the present decade overall income per person has actually declined slightly (Brown 1995).

> ***If development is not engendered, it is endangered. And if poverty reduction strategies fail to empower women, they will fail to empower society.***
>
> (HDR 1996, p. 3)

Such inequalities undermine human development, locally, nationally and globally. Disparities in income produce disparities of impacts. The per capita contribution to atmospheric pollution and global climate change is often orders of magnitudes higher for citizens of the industrialized countries than for those in poorer nations (Ehrlich and Ehrlich 1991). The dominant EuroAmerican socio-economic paradigm, now being promoted throughout the developing world, is a main cause of increasing poverty. The conversion of staple crops to cash crops has contributed to increasing malnutrition and a decrease in the ability to meet basic needs while, at the same time, it has concentrated wealth in the hands of a few, and deprived many from achieving sustainable livelihoods. About 1 billion people still do not have access to diets that can support normal daily activity, and nearly 500 million are slowly starving to death (Daily & Ehrlich 1996).

Paradoxically, with increasing global population has also come homogenization. Just as we are losing biological diversity, it appears that we are losing cultural diversity as well. Brazil, for example, has lost 87 tribes in the first half of this century, and one-third of North American languages and two-thirds of Australian languages have disappeared since 1800 (Durning 1992). Over one half of the world's 6,700 languages are now moribound, and spoken only by people who are middle-aged or older (Harmon 1995). As humanity's linguistic heritage disappears, much of our knowledge, wisdom and history vanishes with it.

All but about 200 of the modern world's 6,000 languages are likely to be extinct or moribound by the end of the next century. The analogy that occurs to me is the final destruction, in A.D. 391, of the largest library of the ancient world, at Alexandria. That library housed all the literature of Greece, plus much literature of other cultures. As a result of that library's burning, later generations lost all but the Iliad and Odyssey among Greek epics, most of the poetry of Pindar and Sappho, and dozens of plays by Aeschylus and Euripides — to mention just a few examples.

(Diamond 1993, pp. 251-271)

Human health is also directly linked to loss of cultural and biological diversity. According to the World Health Organization, over 80 percent of people rely for their primary health care on traditional plant medicines (Dobson 1995). Most villages in the world are no longer surrounded by the natural habitat that formerly provided most of their indigenous medicines; and bodies of folk knowledge are disappearing at an unprecedented rate. It is estimated that one indigenous culture becomes extinct annually in the Amazon Basin alone (Ibid). Plant-based pharmaceuticals are inextricably linked to biological diversity. In the USA, 9 of the 10 top prescription drugs are based on natural plant compounds (Farnsworth 1988), and 118 out of 150 top prescription drugs are based on chemical compounds from other organisms, three quarters of them being derived from plants (Daily & Ehrlich 1996). High population density may also affect human health, by facilitating the spread of contagious diseases such as dysenteries and influenza (Ewald 1994).

Within the next decade, more than half the world's population, an estimated 3.3 billion, will be living in urban areas, a demographic shift with far-reaching negative implications for the environment. It is estimated that by 2025, two thirds of the world's people will be living in urban areas (United Nations 1995). Cities are also reaching unmanageable sizes — Tokyo, 27 million; Sao Paulo 16.4 million; Bombay 11.5 million — placing enormous strains on the institutional and natural resources that support them (Ibid). Most cities now have health-threatening levels of a range of pollutants, particularly, air pollutants, and these burgeoning cities are forever expanding into fragile ecosystems — nearly 40 percent of cities larger than 500,000 are located on the coast (WRI et al. 1996). The ecological imprint of all cities extends far beyond their geographical boundaries (Wackernagel and Rees 1996). For example, London's ecological footprint for food, forest products, and carbon assimilation is 120 times the geographic area of the city proper (Ibid). Similarly, Folke et al (1991) found that the aggregate consumption of wood, paper, and food (including seafood) by the inhabitants of 29 cities in the Baltic Sea drainage basin appropriates an ecosystem area 200 times larger than the area of the cities themselves. Nationally, the total land required to support present consumption levels by the average Canadian is at least 4.3 hectares, including 2.3 hectares for carbon dioxide assimilation alone. Thus, the per capita ecological footprint of Canadians is almost three times their "fair Earthshare" of 1.5 hectares (Wollard and Rees, in press).

Both species and languages have evolved over hundreds or thousands of years to adapt to very specific contexts. If those contexts undergo unprecedented rapid change—as the world's environment and culture are now doing—many species and languages will likely lack the resiliency to adapt to the new conditions.

(Harmon 1995, p. 8)

Air pollution is among the world's worst in Mexico City, with health impacts estimated at about 200 billion dollars a year.

Socially, governments and communities around the world are under unprecedented stress. There is an emerging alienation between the population and the systems of governance in many industrialized countries. Conflict exists between the desire to cut taxes and reduce debt, and to maintain social and environmental programs. This increasing alienation and distrust of government is resulting in significant losses in "social capital" (Cox 1995, Roseland, in press) and, in some inner cities, unprecedented increases in violence and crime. Coupled with this violence is an increasing civic disengagement in American society of approximately 40 percent (Putman 1993), and voting patterns in Canada would tend to support the same trend here. In the former Communist block countries, fragile structures of governance are often barely surviving

An important concept in population biology is that populations tend to maintain themselves in a series of damped oscillations. Digression from this pattern results in severe instability and even extinctions.

Part of this instability and vulnerability to extinction appears to be related to stresses that develop under conditions of high population density and severe crowding. Crowding leads to social and biological pathology that results in high mortality and diminished group survivability.

(Cassel 1971; Aaby et al. 1983)

the stresses of converting to market economies. In developing countries, the strains of poverty, rapid population growth, rapidly industrializing economies with their massive environmental impacts often overwhelm their ability to maintain viable social and cultural systems.

There is growing evidence that the competing forces of centralization and decentralization are leading to various forms of nationalism, tribalism, ethnic strife, separatist movements, and arguably greater susceptibility to demagoguery and political authoritarianism. These sentiments are undoubtedly linked to the growing sense of alienation, fear and loss of community in many parts of the world. Traditional notions of global security are under threat and global security is also threatened by the increase in global arms expenditure. In the post-Second World War period (1945-89), the level of this trade increased, in real terms, four or five times, according to a 1989 United Nations study (Head 1991). More disturbingly, much of this arms trade is to developing countries, diverting necessary expenditures from critical social infrastructure to military expenditures.

> ***One obstacle is the "addiction to war industries," as R.T. Naylor of McGill University puts it. Although small weapons do not figure prominently in the corporate drive for profits and the governmental interest in boosting export revenues, this addiction will be an impediment as long as no effective programs provide economic alternatives to work forces and communities dependent on arms production.***
>
> (Brown et al. 1998, p. 147)

In country after developing country, not least in Africa, expenditures on the defense sector exceed those in social sectors, often more than on health and education expenditures combined (Ibid). The face of conflict is also changing from conflict between major nation states to inter-state warfare. Only 6 out of 101 conflicts in the period 1989-96 were international. An estimated quarter of a million children are soldiers, and children under 18 years of age were among the combatants in 33 current or recent conflicts (Brown et al. 1998). In addition to major weapons systems, therefore, hundreds of millions of low-tech, inexpensive and easy-to-use weapons are the new tools for most killing—causing as much as 90 percent of the deaths. An estimated $3 billion worth of small arms and light weapons are shipped across borders each year (Ibid). Such an arming of the world, combined with the decline in social capital, has clearly exceeded the "carrying capacity" of our ability to govern in many places in the world.

The preceding data illustrate the psychopathology that occurs when a civil society designs and operates its systems without adequate reference to the interrelated nature and reconciliation of ecological, social and economic imperatives. There are numerous pervasive and systemic barriers that work against such a reconciliation, and changes of the magnitude required to move to more sustainable societies in both the North and the South are socially problematic. The measures required in both the North and the South may at first appear paradoxical, but in reality, they may actually converge through reconciliation and integration of

> *Modern humans, though, do introduce a troubling novelty. They have uncoupled decisions about reproduction from production. The ability to make decisions about future ecosystems-carrying capacity does not lie with reproducing units, and rapid feedback regulation could hardly be expected.*
>
> (Haraway 1991, p. 103)

these three imperatives. Whether social transformation of this kind is possible globally will be the challenge of the next decade. Fundamental changes will have to be made in the way we make decisions, in the way we do business, in our social constructions of the world and of the place of the human species in the biosphere if we are to achieve the meaningful implementation of sustainable development to safeguard the future of successive generations.

It is clear that the increasing globalization of human activities and large-scale movements of people means that humankind is in an era of moral co-evolution of ecological and socio-economic systems at regional and even planetary levels (Holling 1994). In biology, co-evolution refers to the pattern of evolutionary change of two closely interacting species where the fitness of genetic traits within each species is largely governed by the dominant genetic traits of the other. Co-evolutionary explanations, therefore, invoke relationships between entities that affect the evolution of the entities. Everything is interlocked, yet everything is changing in accordance with the interlockedness. Co-evolution is organic and unpredictable because of the interactive effects between human and natural systems, and in human systems can be depicted by the following model (Figure 5.1).

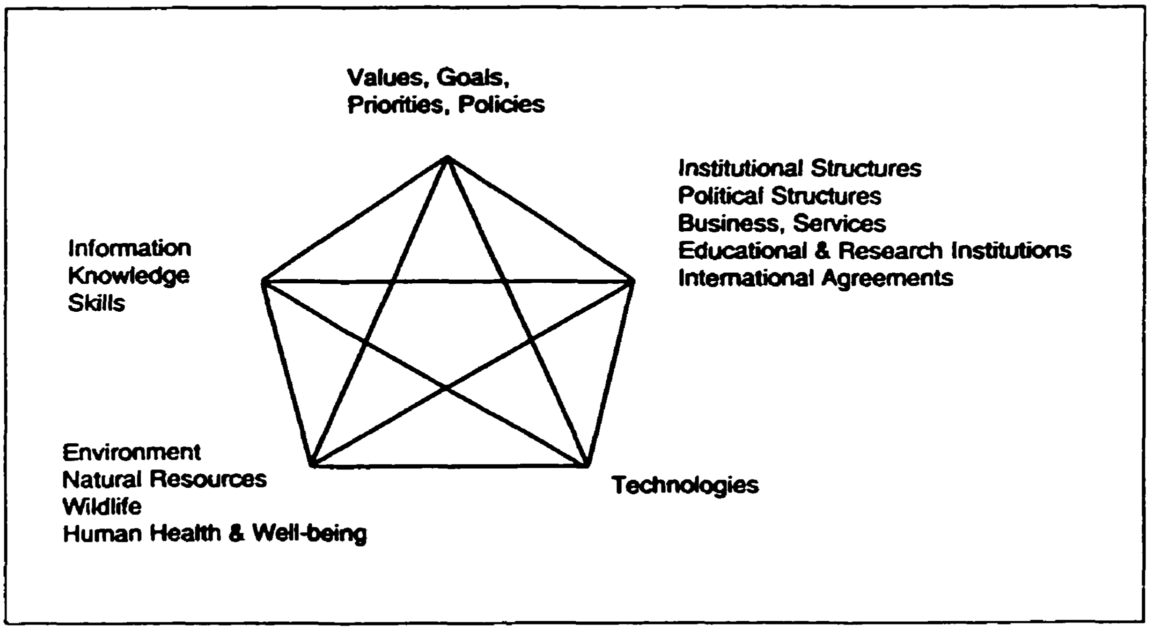


Figure 5.1 Main areas to consider to achieve co-evolutionary sustainable development (Norgaard 1994, modified by Hill 1994)

Norgaard uses the co-evolution of pests, pesticides and policy in the twentieth century as an example of the co-evolutionary process. With the discovery of DDT in 1939, and other organochlorine insecticides soon after, the use of insecticides expanded dramatically after World War II. Their initial effectiveness set off a spiraling co-evolutionary process between pesticides and pests. The few insects that survived were the ones most resistant to the pesticide, and a high proportion of their offspring carried the genetic traits that favoured resistance. Given the number of insect generations in a season, the selective pressure of insecticides on the evolution of resistance was dramatic. Coupled with the problem of more and more species of pests developing resistance, thereby necessitating greater and greater use of insecticides, was the opening of niches for secondary pests less susceptible to the spraying for a variety of reasons. Their resurgence was even greater than would occur through natural processes because of the competitive niche opened up by the demise of their cohorts. Because the sprays are invariably more lethal to the predators than the pests, the pest populations return even faster. Ironically, in spite of this pesticide treadmill, crop losses to insects are about the same as they were before the use of modern insecticides (Norgaard 1994).

Keeping in mind Norgaard's co-evolutionary process (Figure 5.1) and Holling's ecosystem model (Figure 4.1), how can the dominant paradigms and prevailing myths and metaphors be changed and used for the social reconstructions so necessary for sustainable development? Since the 1930s, there has been an impressive amount of literature produced arguing for alternative paradigms and ways of viewing the world and human relationships. Yet, there has been a systematic refusal by mainstream agendas to debate these alternative paradigms. With reference to the above diagram, institutional and political structures, in conjunction with technologies, exert powerful influences on the other four spheres. In some ways, they colonize the other areas to maintain their influence and power, for example, technology can become a powerful "shaper" of the other four points. As elaborated further in Chapter 8, the larger the scale of human activity, the greater the rate of change and dependance on increasing technology.

Unless we think about fundamentals, our specific measures may produce new backlashes more serious than those they are designed to remedy... The issue is whether a democratized world can survive its own implications. Presumably we cannot unless we rethink our axioms.

(White 1967)

Astounding shifts in vision have happened before, most recently, the collapse of the Berlin Wall and the break-up of the monolithic Soviet Republic. What we should avoid doing is simply trying to fix the existing dominant socio-economic paradigm which has systematically degraded both ecological and social capital, and is in the process of distorting economic capital. Deeper ways exist, however, that can challenge and hopefully change these pervasive influences. One of the questions we have to ask ourselves is whether strengthening civil society means hiring more policemen, or encouraging more people to know their next door neighbour's name (Putman 1996).

Williamson's (1980) concept of mutual synthesis, derived from years of study and research from the *Peckham Experiment,* provides another lens on our relationships with the world. Instead of the planner's view of the environment as innately hostile, passive or dead, Williamson viewed the environment as a field of function where individual and environment work in strict mutuality. This mutuality is characteristic of even the simplest cell, and common to all living beings. Thus, the amoebae encountering a particle of food in its environment engulfs and digests it. "Once within the body the morsel is picked to pieces, chemically analyzed, sorted out and separated. Certain selected portions are then as it were reshaped and woven into its very substance according to its specific order, thereby adding to and developing its unique basic design" (p. 27). A process that Williamson described as "synthesis", meaning the "living power to build up a basic organic design from the substance of the environment." This process of synthesis is identical whatever the interaction, be it food, light or social relationships. It is mutual, an unending process between living organisms and their environment. The healthy individual, therefore, is one who enjoys a buoyant and creative mutuality with the environment.

At the individual level, education has a critical role to play in changing our consciousness around dominant paradigms and mythologies. An important first step will be to integrate ecological literacy (Orr 1994) into every secondary school curricula by the third grade. Another step, in addition to teaching ecosystem principles, would be to model them by redesigning schools based on the structure, processing and functioning of ecosystems, where applicable. In addition to developing an ethos of life-long learning, teaching self-conscious learning by illustrating cognitive complexity can visibly demonstrate to young students how their worldviews are strongly shaped by their physical environments and cultures in which they live. By what and how they teach, teachers are at the forefront of teaching children that they are either apart from or part of the natural world. Getting students to suspend trust in their abilities to see the world as it is may be the most important step they can take in developing the analytical dexterity required to think critically. Critical thinking, however, is not easily taught because it requires students to call into question their own ability to see clearly, to question what Ornstein and Ehrlich (1989) refer to as the 'old mind'. For the 'new mind' to emerge, the relationships between the inner world and the external world will need to be brought into consciousness.

Optical illusions can illustrate how easy it is to make snap judgments that there is really only one way to see a phenomenon when in reality there are many. Children can then learn how to develop a set of lessons or proverbs (stories) that flow from their experiences within multiple valid contexts. In addition, appreciating the importance of context and of the uniqueness of each situation are important tools for self-conscious learning. When students see that they can arrive at erroneous conclusions because their contextual appreciation of the image distorts perceptions of reality, then they can appreciate how cultural and value frames serve as filters (and distorters) of the information that we process daily (Ibid).

Another important tool for self-conscious learning is to make explicit the old mind default mechanisms through which we tend to over-simplify our day-to-day decision-making. Everyone, therefore, needs to learn how they cut mental corners to make decisions and how these cognitive short-cuts then lead to systematic caricatures that prevent us from being objective in certain kinds of judgments (Ornstein and Ehrlich 1989). New competencies in decision-making with high levels of uncertainty, imprecise information, and rapidly and slowly changing contexts will have to be taught, as well as accepting errors in order to learn (Michael 1993), in order to drive changes at the system level. Fundamental changes are needed in our institutions and policy frameworks, and the development of appropriate institutions depends, among other things, on understanding ecosystem dynamics and relying upon appropriate indicators of change (Arrow et al. 1995). Changes are also needed in the way we structure knowledge and use information for decision-making, in the choice and design of our technologies, in our social constructions of the world, and our institutional relationships based on gender equity, and most fundamental of all, on our value systems. An illustrative sampling of different ways of organizing for sustainable development is provided in Appendix N.

> ***It seems to me that over-population and over-consumption are key drivers for unsustainability, but that the long-run problem is the structure of the polity and human societies. If one looks at population and consumption as cultural systems, then both cultural systems (North and South) are unsustainable and both have to change. There is a political economy of fertility and consumption, and we need to look at decoupling decisions of fertility and consumption from their cultural context.***
>
> (Dale, Electronic Dialogue, November 17, 1996)

> ***Specifically, if theory and common sense locate our humanness outside of, or transcendent to ecological fields and considerations, we will continue to reproduce alienation and problematic cultural dualisms. Running counter to this ecological alienation, greening is a reaction against many of the prevailing paradigms of modernity. For deeper green theorists, the development of new discourses involves paradigm shifts and decenterings across human spheres. Ecological vision locates humanity in an extended community of other life forces and their ecologies. In working toward the preservation of ecologies and the cultivation of ecological awareness, dichotomies are transgressed, identities shifted, and the self becomes extended and inclusive.***
>
> (Jagtenberg and McKie 1997, p.125)

A key social imperative, therefore, is to develop principles for human activity systems that provide a basis for a more sustainable co-evolution with natural systems over the longer term. Examples of some of these principles are described in Appendices L and O.

Humanity's only chance of creating a sustainable civilization depends on global cooperation. The scale of the human enterprise must be adjusted so that the size of the human population falls again within Earth's carrying capacity.
(Daily, et al. 1996)

This task is extremely challenging, given the influence of the expert-driven, rational decision-making model. Brewer (1986, p. 467) argues, that "prevailing attitudes and styles of knowledge creation and uses have too often done precisely the opposite — by denying the legitimacy of different perspectives and preferences, by adhering narrowly to intellectual paradigms ill-suited to the challenges (and then dissolving into brittle squabbles when the limitations of each are exposed), and by favoring tools and methods used to solve problems only remotely like those facing us (and continuing to use them despite lack of success)". Another essential condition for sustainable development realization may be the decoupling of what has been traditionally defined as human progress from its historical attachment to growth as the basic engine for improvement of human welfare (Pierce, in press).

If sustainable development is to be realized in the next century, some of the key social imperatives will be: the education of women worldwide; the elimination of poverty worldwide; massive public education programs to increase ecological literacy including a targeted program for political decision-makers; gender equity in political parties and the reconciliation of the ecological, social and personal imperatives.

Economic Imperatives

Poverty is a human contruct. The way economic resources are distributed is not a function of unchangeable economic laws, but of political—that is—human choices
(Sign outside St. Anthony's Church, Ottawa)

The preceding chapters have illustrated the widening social disparites and growing inequities among nations. One-fifth of humanity now consumes four-fifths of all the Earth's resources (Independent Commission on Future Population and Quality of Life (ICFPQL) 1996). Whether or not we can grow our way out of this dilemma is one of the crucial issues currently facing both developed and developing countries. Growth in all its dimensions represents one of the greatest parodoxes facing human societies in the 21st century. On the one hand, it appears to provide for human material well-being, on the other, it also contributes to decreasing ecological and social capital, as outlined in Chapter 3. Even its ability to provide well-being is being refuted, as the link between growth in production and the creation of welfare has begun to weaken, so that we are now faced with the curious phenomenon of production growth leading to a decline in welfare (Common and Perrings 1992; Daly and Cobb 1989; Dasgupta 1995, and Tietenberg 1992).

A world economy that thrives on relentless exploitation of natural resources, depending perilously on fossil fuels, causing limitless waste, and remaining oblivious to the precepts of equality and equity among different societies, is neither sustainable nor tolerable.
(ICFPQL 1966)

When the Club of Rome published *Limits to Growth* in 1972, it sparked intense international debate by fundamentally challenging the widely held belief by economists that growth is inherently good. This dualistic argument, growth versus no-growth, continues today, strongly reinforced by the dominant socio-economic paradigm depicted by Figure 3.1. As well, since the 1970s there have been major debates about the degree to which the economy is an open or closed system (Daly 1991; Hawkens 1997; Pearce 1993; Pearce and Turner 1990). The current prevalent economic paradigm sees the economy as an isolated system, a circular flow of exchange value between firms and households, as depicted in Figure 6.1.

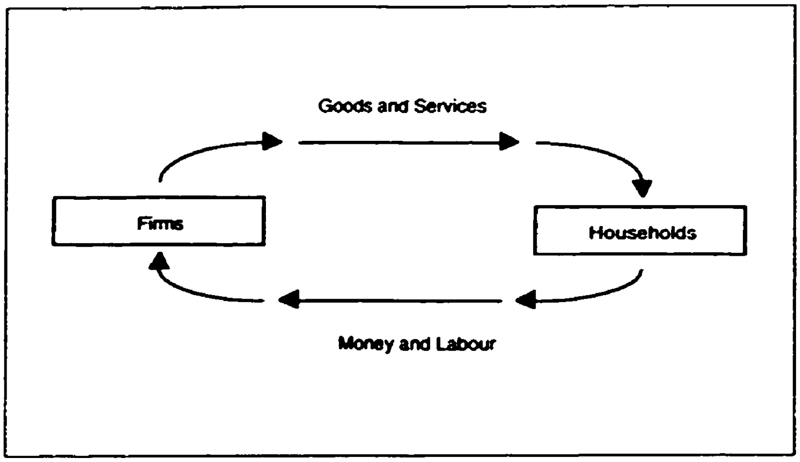


Figure 6.1 Open economic system

The economy is the political system of interest and natural systems are simply regarded as sources of resources and sinks for wastes. Nature may be finite, but many economists believe these natural sources and sinks can be indefinitely substituted for by human ingenuity without limiting overall growth in any significant way. In this paradigm, instead of economic theory acknowledging its embeddedness in the real world of physical reality and contexts, economic theory seeks to expand to include its context (O'Hara 1995). Not land (nature), but human labour and capital creation are seen as the source of economic progress, a fundamental and artificial separation of human and natural systems.

An alternative view, steady-state economics (Daly 1973), sees the economy, in its physical dimensions as an open subsystem within a finite, non-growing and materially closed total system - the earth, ecosystem or biosphere - as depicted in Figure 6.2.

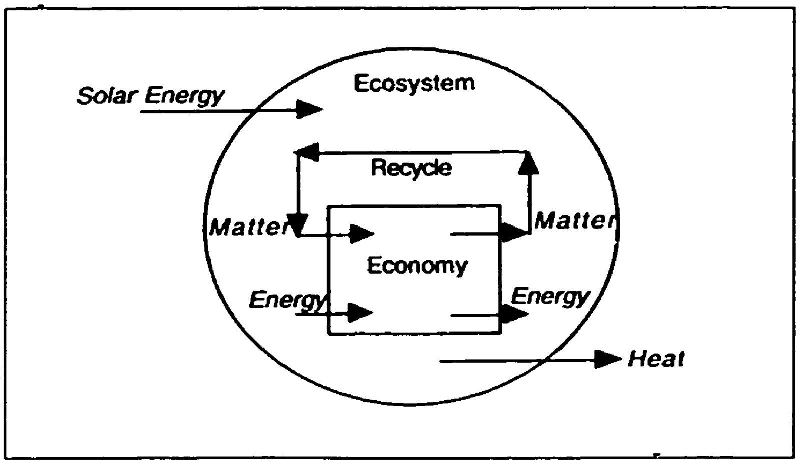


Figure 6.2 Closed economic system (Daly 1992)

Economists have constructed a system which is illustrated with a diagram of arrows going from raw materials to processing, to manufacturing, to merchants, to consumers and so on. It suggests that, by manipulating the interacting parts, the economy can be "managed". But when we ask where the air, water, soil and biodiversity are in the diagram, we are informed they are "externalities". Thus, the economy is fundamentally disconnected from the real world that supports us; it is an illusion.
(Suzuki 1995, p. 19)

The growth of the economy is, therefore, constrained by the physical carrying capacity of the larger biosphere. In this latter view, human and natural capital are regarded not as substitutes, but rather, as complements. In fact, Daly cautions that we may be facing an historic juncture in which, for the first time, the limits to increased prosperity are not the lack of human-made capital, but the lack of natural capital. Debates on growth continue, however, with no greater resolution than in the early 1970s.

I believe one of the principal mistakes of human systems has been to view ourselves as separate from our environment and not part of it. Moreover, we have not accepted the notion of biospheric limits (Commoner 1975; Meadows et al. 1972; Odum 1975; Mishan 1969; Pearce and Turner 1990, Wackernagel and Rees 1996). Thus, we perceive the environment and economy as separate cycles connected by a one-way movement of resources from nature to human kind. Paradoxically, ecological and economic systems, in fact, have very similar needs in terms of maintaining essential structures and ensuring performance. They each require energy, elemental diversity and free-flowing circulation in order to function. As described in Chapter 3, ecosystems can be characterized as primarily concerned with maintenance of the system. Human activity systems have become mainly concerned with production and consumption, with little or no emphasis on maintenance and rehabilitation; and growth is regarded as central to fueling the production processes of human activity systems. Unfortunately, there are no new frontiers left for virgin exploitation, although as discussed in the preceding chapter, we are doing our best to open up new possibilities by imposing monetarized economic systems on the developing world. The preceding two chapters demonstrate that somehow, human activity systems must now begin to reconcile methods of production processes and consumption patterns with the essential maintenance of ecosystems that provide the ecological services for all life.

Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth—the composition of inputs (including environmental resources) and outputs (including waste products). This content is determined by, among other things, the economic institutions within which human activities are conducted. These institutions need to be designed so that they provide the right incentives for protecting the resilience of ecological systems. Such measures will not only promote greater efficiency in the allocation of environmental resources at all income levels, but they would also assure a sustainable scale of economic activity within the ecological life-support system. Protecting the capacity of ecological systems to sustain welfare is of as much importance to poor countries as it is to those that are rich.
(Arrow et al. 1995, p. 15)

> *Conventional economic theories will not guide our future for a simple reason. They have never placed "natural capital" on the balance sheet. When it is included, not as a free amenity or as a putative infinite supply, but as an integral and valuable part of the production process, everything changes. Prices, costs, and what is and isn't economically sound change dramatically.*
>
> (Hawken 1997, p. 42)

Achieving such a reconciliation without growth in human systems will prove to be impossible without a paradigm shift in economic thought. On the one hand, some argue, economic growth or development has the ability to raise the material standards of a large number of people around the world, and indeed, represents the only way the needs of the planet's growing human population can be met (Brundtland 1987). And others claim it is impossible for the world economy to grow its way out of poverty and environmental degradation. As the economic subsystem grows it incorporates an even greater proportion of the total ecosystem into itself and must reach a limit of 100 percent, if not before (Daly 1990, see also Rees and Wackernagel 1994).

This debate is both psychopathological and counter productive, as biophysical evidence continues to mount and make clear that the products of our growth and consequent consumption patterns are slowly destroying the very habitat on which we depend. This discussion is further complicated by the schizophrenic refusal of both the North and the South to recognize and respect limits on their own behaviour. Whereas the former is finding it hard to accept limits and responsibility for their increasing consumption, the latter is finding it equally difficult to recognize limits and responsibility for their increasing global population pressures.

> *Take the giant, airy American strawberry. Genetically recombined for improved size, and growth of degraded soil, it looks great and tastes like nothing. In the medium term, even its comparative price has fallen. It is a symptomatic industrial product: seemingly wonderful, yet it has literally less substance, and hence less value.*
>
> (Brennan 1997, pp. 182-183)

In fact, there is a hyperactive rhythm of consumption that underpins the dominant socio-economic system in North American society. For example, modernizing agriculture has increased the speed and diversity of acquisition through increasing scale, which then depends on whole networks of processing, distribution, and storage as does industrial production; and whereas agriculture could be a net producer of energy (through carbon fixation in photosynthesis), it is now an energy sink. To acquire more at a faster speed for production, means distributing more, and consuming more natural substances in order to feed the faster rates of production. This then puts pressure on agriculture to produce at a rate comparable with other aspects of production and distribution. As available local sources of energy in either agriculture or industrial production are diminished, capital has to create routes for the old sources of energy to come from farther away, or to create new sources of energy altogether, ranging from chemical inputs to nuclear power (Brennan 1997). To the extent that capital's continued profit must be based more and more on the speed of acquisition, it must centralize more, and command more distance, and in this respect, short-term profit takes precedence over the generational time of natural reproduction (Ibid). Thus, more and more space is appropriated by socio-economic systems predicated on growth and perceived as isolated systems. Perhaps even more important are the impacts of this economic system on social cohesion and the quality of life, in terms of crime, depression, addiction of all forms, violence and mental illness, and spiritual emptiness (Trainer 1996).

The crux of the issue then is whether to continue to regard the economy as an isolated system, or as an open subsystem of a finite system. If the former, then there is no environment to constrain the continual growth of the economic system. If, however, we view the economy as a subsystem of a larger, but finite biosphere, then obviously growth is limited by its finiteness. The economy may continue to develop qualitatively, but it cannot continue indefinitely to grow quantitatively; at some "sustainable" point it must approximate a steady state in its physical dimensions.

Another issue central to this debate is substitution, and the degree of substitutionability between produced and natural capital (Daly and Cobb 1989; Daly 1991; Turner 1992). Some economists believe in fixed coefficients, the opposite of substitution at the margins. For example, during the 1970s, the Club of Rome in its report, *Limits to Growth*, used fixed technology and no substitution in its modeling, and as a result predicted an apocalyptic collapse sooner than would be likely because of the still limited ability of substitution to postpone the inevitable need to halt growth. Some experts, however, believe that with human ingenuity, the ability for flexibility and substitutability in the economic system is enormous. They argue that because of the uncertain limits of human ingenuity, it is impossible to predetermine the future trends and limits of technological development. In addition, Lipsey (1995) maintains that most technological development benefits economies with respect to both the environment and the economy; by using less of all inputs, technologies, and becoming absolutely more efficient over time. He argues that we should do our best to manage sustainable growth and that growth, if it is to be maximized, must occur through technological change. Regardless of one's technological lens, however, it is now generally recognized that there are limits to the possibilities for substitution between natural and produced capital, although there is considerable debate about the nature and degree of those limits (Meadows et al. 1992). All technological growth, whether efficient or not, still eventually increases both consumption and impacts on the environment.

My research is based on the premise that we live in a closed system — the biosphere — and that there are important limits to its carrying capacity that are difficult to determine and predict; therefore, the precautionary principle must prevail. Ecosystems are the key "factors of production", and they are becoming increasingly impacted and diminished (Barbier et al. 1994; Jansson et al. 1994) as a consequence of the growth of human activity systems. Because many of the most important environmental effects of human activity systems are not recognized and valued in market prices, it is clear that current social institutions in society, including markets, are presently incapable of responding to environmental feedbacks (Berkes and Folkes 1994). We should, therefore, deliberately attempt to keep our economic system well below critical ecological thresholds, especially given our imprecise information, incomplete knowledge and the dynamic complexity of the interlocutory effects of ecological, social and economic systems. Moreover, we can anticipate that our knowledge and information will never enable us to completely control and manage complex and dynamic living systems.

Plumwood defines five features that are typical of dualisms: backgrounding (denial); radical exclusions (hyperseparation); incorporation (relational definition); instrumentalism (objectification), and homogenization or stereotyping. Through backgrounding, economics establishes common "ways to deny dependency" through disempowering an other "by denying the importance of the other's contribution or even his or her reality".

(Plumwood 1993, p. 48)

If one accepts the need for steady-state economies, then compelling and socially complex questions emerge for civil society and its definitions about what constitutes sustainable development. What is the optimal scale of the subsystem relative to the entire system? If one accepts the reality and necessity of limits, is it implicit that we live at the limit, or should we live some way below the limits to allow space for other species, or at least a safety margin for ourselves?

Another key characteristic of our current human activity systems is change (Toffler 1977), and the rate of that change has been greatly influenced and hyper-stimulated over the past few years by globalization. Henderson (1991) has identified six driving forces for this globalization —industrialism/technology; finance/communication/information; employment, work, migration; human effects on biosphere-pollution; militarization; and globalization of consumption, culture, media-driven world citizenship movements. In addition, there is a seventh globalization characteristic of interactions, responses, re-alignments and re-structurings.

But what is the scale of this global economy? Global economic output expanded from \$3.8 trillion in 1950 to \$18.9 trillion in 1992, a nearly fivefold increase, and world trade soared from total exports of \$308 billion to \$3,554 billion, an 11.5 fold increase (Korten 1995). Just as industrialization fostered the separation of land from production, consolidation combined with the twinning of computerization and globalization has created another new (artificial) separation, delinking money from production. For example, investment decisions once

Cross effects depend on the connectedness between any two systems. The more strongly connected ecological and economic systems are, the more change in one implies change in the other: the more they 'coevolve'.

(Norgaard 1984)

taken by many individuals are now increasingly consolidated in the hands of a few investment managers. The pool of investment funds controlled by mutual funds has doubled in three years to total $2 trillion at the end of June 1994, as individuals placed their savings in professionally managed funds (Korten 1995). As well, Joel Kurtzman, the editor of the Harvard Business Review, estimates that for every $1 circulating in the productive world economy, $20 to $50 circulates in the economy of pure finance, that is, the money markets (Ibid); and these are similarly in the hands of individuals who have essentially no knowledge of the limits of ecological systems.

Linked to this consolidation of individual investors is a corresponding concentration of multinationals, with sweeping ramifications for national sovereignty. This "concentration without centralization" has four interesting elements of transformation, namely, downsizing; computerization and automation; mergers, acquisitions, and strategic alliances; and, headquarters teamwork and morale (Korten 1995). The deliberate or unanticipated result is a dualistic employment system of corporate headquarters staff very well-compensated with a complementary periphery of temporary or part-time contingent employees.

Globalization is also underpinned by a variety of legal instruments, such as the North-American Agreement on Free Trade (NAFTA) and most recently, the Multinational Agreement on Investment (MAI). This agreement, developed by the 29 member nations of the Organization for Economic Cooperation and Development (OECD) has some very unique features. For example, it would allow investors the unrestricted right to buy, sell, and move businesses, resources and other assets wherever and whenever they want; it would override all "unconforming" local, state, and national laws and regulations; it would severely restrict the ability of governments to impose obligations on foreign corporations; and it would allow corporations to sue non-conforming cities, states and national governments before an international tribunal composed of judges largely of the corporation's own choosing.

Advocates of MAI argue that reducing restrictions on capital is a logical next step after treaties such as NAFTA and GATT reduced restrictions on the mobility of goods and services. Opponents of MAI contend that capital, unlike other economic factors, brings with it power and control. In addition, the MAI codifies and reinforces the increasing tendency of modern economies to separate those who make the decisions from those who feel their impact, a complete and utter separation of capital from physical space; and economy from ecology.

MAI offers capital a right that even GATT does not. Under the agreement investors and corporations could sue governments directly, a privilege that NAFTA already allows. On April 17, 1997, the U.S.-based Ethyl Corporation became the first corporation to exercise this right by suing the Canadian government. The Ethyl Corporation/MMT case demonstrates the changing nature of state sovereignty under these international trade agreements. MMT is a manganese-based compound that is added to gasoline to enhance octane and reduce engine knocking. The United States Environmental Protection Agency (EPA) has banned its use in formulated gasoline, which includes approximately one-third of the American gasoline market. An Environmental Defense Fund (EDF) survey of the remaining producers report that none use the additive, and California has imposed a total ban on MMT.

Canadian legislators wanted to ban the use of MMT in order to protect the Canadian public. Because they could not do so under the Canadian Environmental Protection Act (CEPA) provisions, they chose the best available alternative: banning MMT's import and transport. Ethyl, (the company that invented leaded gasoline) responded to the Canadian Parliament's act to ban the import and interprovincial transport of an Ethyl product, by filing a lawsuit against the Canadian government under NAFTA. Ethyl claims that the Canadian ban on MMT violates various provisions of NAFTA and seeks restitution of $251 million to cover losses resulting from the "expropriation" of both its MMT production plan and its "good reputation." Consequently, the Canadian government withdrew its ban in July 1998.

There are two dimensions to materialism as a worldview: economic and scientific. The latter is absolutely essential to the former, and may even be the prerequisite for its existence. This other materialism is the philosophy that nature is nothing but physical matter organized under and obeying physical laws, matter rationally ordered but devoid of any spirit, soul, or in-dwelling, directing purpose. On this view of nature converge many of our modern university departments of learning along with our extra-academic institutions of research and development, governmental bureaucracies, and multinational corporations, all of which tend to approach nature as nothing more than dead matter.

(Worster 1993, p. 211)

As discussed in the social imperatives chapter, there is also considerable debate about whether or not poverty and income disparities will be made worse or better by this trend toward global economic integration. In fact, it appears as if real incomes of the middle class are decreasing in industrialized nations, at the same time that poverty is increasing (Korten 1995), with a disturbing accelerating trend towards the feminization of poverty (Kettel 1996). In spite of growth in corporate profits, the usual linkage between growth in the bottom line and employment has also been broken, through technological innovation and a disappearance of any corporate responsibility to geographical place. Most industrialized countries are undergoing significant downsizing in both the corporate and government sectors. Indeed, in parts of the industrialized world, unemployment and underemployment have risen faster than employment for more than 25 years (Hawken 1997).

How well does the current economic system support the welfare of people locally and globally? Korten (1995) and Mishan (1977) maintain there is little basis for assuming that economic growth, as it is currently defined and measured, results in automatic increases in human welfare. Daly and Cobb (1989), after adjusting the national income accounts to count only increases in output that relate to improvements in well-being and adjusting for the depletion of human and environmental resources, show that, on average, individual welfare in the United States peaked in 1969, then remained on a plateau until it fell during the early to mid-1980s. Yet from 1969 to 1986, GNP per person went up by 35 percent, and fossil fuel consumption increased by around 17 percent. Despite the economic growth in the Third World between 1960 and 1980, the gap in real income between the rich and poor nations increased from a factor of 20 to a factor of 46, and that gap continues to increase (Hawken 1997).

Nor do markets appear to be effective in their ability to distribute wealth and create employment. It could be argued that the economic system, despite it's systemic problems, appeared to be effective in maintaining a civil society, by creating a large middle class through the economic development of the 1950s and 1960s. Inflationary pressures of the 1970s, however, resulted in a slowing of this process. Thus, in the 1990s, in addition to the growing gap in income between the rich and poor nations, the gap between the rich and poor in developed countries is also increasing, and in Canada, the middle class is shrinking (Rees, personal communication). Nor does the global trading system value creating employment opportunities in communities, striving as always for competitive advantage, going to those markets where labour is cheapest, and regulations minimal, regardless of the conditions. As the forces for globalization continue to accelerate and corporate activity is no longer tied to a sense of place, there is little or no social obligation for communities and nations to create work for people, nor even maintain the regional resource base.

Since 1950, the total manufacturing output in the USA has increased more than three-fold, energy use has tripled and capital expenditure has quadrupled, but employment has only increased by one-third. As industrial production is thus being transformed, and as transnational corporations redefine the world's labour markets to minimize their production costs, so unemployment grows in the traditional industrial sectors of rich countries.

(McMichael 1993, p. 305)

Although this intense globalization of the economic system appears to be creating space for new avenues of economic growth, it is merely an illusion. Hawken (1997) points out that the American economy may not be growing at all, and may have ceased growing nearly 25 years ago, if depletion of natural capital is factored into GNP measures of growth. Thus, we may well be reaching our last frontiers, and absolute limits to growth are being imposed by the biosphere. There is considerable evidence (Chapter 4) that most of this economic growth has been at the expense of natural capital, some in very critical areas. Given our current rates of natural capital depletion and continuing human appropriation of carrying capacity, it is clear that our current economic system is unsustainable ecologically. In other words, it is destroying the essential inputs on which it depends, and is also beginning to deplete "social capital" through its current inability to generate wealth and rising income disparities and inequalities.

There are four underlying driving forces for the systemic decline in ecological capital. First, unrestricted access to a resource and unsustainable management of a common good reflects the imperfect allocation of property rights, for example, water (Hawken 1997). Second, mismatched rights and obligations and other market imperfections (externalities) can cause value and price to diverge, for example, a tall building's shadow over a previously sunlit park will not be captured in its price structure. Third, there are a myriad of ecologically damaging and economically perverse neglected side-effects of government initiatives, such as most subsidies to industry (MacNeill 1989). Fourth, the measures of economic progress, such as GNP, are seriously flawed and based on improper information because of the previous three forces.

One of the greatest mythologies of the dominant socio-economic paradigm is that we live and work in a free market system. In reality, this market system is significantly supported by public monies. Commercial fisheries, for example, cost much more than is gained by the economies of the world. At present, the annual worldwide catch has a market value of about US $70 billion, yet costs $124 billion to land. The difference — $54 billion — is made up in subsidies, in tax dollars (Earle 1997). With respect to energy, most nations spend several times more taxpayer dollars in ways that encourage greater consumption of fossil fuels than they do on encouraging greater efficiencies, or the use of alternatives. In Canada, the ratio is more than 3 to 1 (MacNeill nd). There are subsidies to encourage the use of the automobile, including road construction and externalized costs, and encourage the mining of minerals and the cutting of forests. For example, worldwide reductions in the use of hydrocarbon fuels are impeded by the annual subsidy of about US $2400 U.S. per year per automobile (Brown et al. 1988). In the case of fiscal bias in the treatment of virgin versus recycled material, this bias amounts to almost $400 million annually, a significant barrier to the use of recycled material and one with clear environmental implications (Bregha et al. 1995). Thus, taxpayers are mostly unknowingly spending several times more to promote global warming and acid rain than to reduce it; and there are also other negative effects associated with technological innovation and competitiveness (MacNeill nd).

Deficits would disappear if some of these subsidies were eliminated. The problem is not the ability to pay, nor is it an environmental problem, nor a lack of knowledge, but a political problem. Clearly, political institutions can be changed in response to changing circumstances, but our interdependence with natural systems cannot be altered.

(Ludwig 1996)

Taxes and subsidies are information that influence behaviour. The most fundamental policy implication, therefore, is simple to envision, but difficult to execute. We have to revise the tax system to stop subsidizing behaviors we don't want (resource depletion and pollution) and to stop taxing behaviors we do want (income and work). We need to transform, incrementally but firmly, the sticks and carrots that guide business.

(Hawken 1997. p. 53)

International armaments remains one of the most heavily subsidized industries (Head 1992). Tax dollars are used to subsidize the disposal of waste in all its forms, from landfills to deep-well injection to storage of nuclear waste. All of these subsidies continue to encourage the persistence of an economy in which 80 percent of what we consume gets thrown away after one use (Hawken 1997). According to Robert Ayres, a leader in studying industrial metabolism, about 94 percent of the materials extracted for use in manufacturing durable products become waste before the product is even manufactured (Ibid 1997).

What is the global magnitude of this subsidy regime? A recent study undertaken by De Moor and Calamai (1997) for the Earth Council examined four sectors: water, transportation, energy and agriculture. In these combined sectors alone, subsidies ranged between $700 and $900 billion per year. Moreover, the study revealed that most of these subsidies no longer serve their original purposes and now actually harm economic prospects. In most cases, therefore, they had become often socially perverse, environmentally destructive and trade distorting, and in most countries all three at the same time (MacNeill nd). MacNeill has further estimated that, based on his work with the Brundtland Commission, the global spending on these subsidies that undermine sustainable development is approximately $1.5 trillion.

To create a policy that supports resource productivity will require a shift away from taxing the social "good" of labor, toward taxing the social "bads" of resource exploitation, pollution, fossil fuels, and waste. This tax shift should be "revenue neutral"—meaning that for every dollar of taxation added to resources or waste, one dollar would be removed from labor taxes.
(Hawken 1977, p. 59)

The most critical step in moving to more sustainable economies, therefore, is to identify and then systematically eliminate subsidies that encourage unsustainable extraction and consumption of resources and waste production. The next step is to then create incentives for people and economies to act more in harmony than in conflict with essential processes that maintain the dynamics and structure of ecosystems (Folke et al. 1996).

There does exist within the context of sustainable development, prospects to reconcile the economic and ecological imperatives, at least in open industrialized economies like Canada. A traditional suggestion in response to the increasing global integration of the world's economies, is that high wage, resource-based industrialized economies like Canada's must increasingly move towards a future based on higher information-rich content goods and services. Indeed, such an economy will be required if we wish to continue to compete in an increasingly integrated and competitive global market-place, characterized by very mobile capital and investments flows and decreasing barriers to such movements.

Moreover, the economic and social development needs of Southern countries, economies in transition and rapidly industrializing economies are such that greatly expanded flows of investment capital, and trade activity, may be required merely to maintain the present although often inadequate growth rates in those countries, unless the twin forces of globalization and consumption can be changed in the near term. At the same time, industrialized countries are increasingly dependent on export revenues derived from trade with these areas of the world, as reflected in the expanding size of their ecological footprints (Rees 1994). This expansion of the economic needs of Northern countries to the South has particularly been facilitated by the structural adjustments mandated on those economies through Northern aid programs, and international monetary institutions such as the World Bank and the International Monetary Fund (IMF). Clearly, both these options, if one accepts the arguments for limits to the carrying capacity of the biosphere, will predictably cause world-wide ecological collapse in a shorter time-frame.

Sustainable development, because of the inevitability of ecological limits, will increasingly become an emergent force for industry and its practices, and adoption of more sustainable industrial processes and practices, politically, economically and institutionally proactively, will benefit our competitive world position in the next century. This lesson has already been learned by an increasing number of leading German, Japanese, some North American, Scandinavian and Swiss industries, which when pressed by high world oil prices and tight emission standards, invented many of the industrial technologies of the 1980s and 1990s. They were not only energy, resource and environmentally efficient; but also internationally competitive, as evidenced by their domination of the market share in almost every sector - from automobiles to pulp and paper, food processing, the service industries, and communications (MacNeill 1991). And they have only scratched the surface of such opportunities, those involving fundamental redesign – where the major advantages will be realised – have yet to be developed (Hill and MacRae 1995).

BMW has pushed the recycled portion of a car to 80 percent by weight and is aiming for 95 percent.

This deconstruction and reprocessing process means large increases in employment.

(Brown et al. 1996)

There may well be a strategic opportunity here for Canadian society and business to go beyond thinking of environmental and economic agendas as necessarily in conflict; of economic activity as undermining sustainability; and of ecological sustainability as a constraint on economic activity. It may be that ecological and economic imperatives, if interpreted and acted upon imaginatively, can actually reinforce one another and be reconciled by supportive government

While business teaches us effective forms of human organization, environmental science reveals that those forms do not necessarily preserve the natural resources that are the basis of our well-being. While business teaches how to gain financial wealth, ecological understanding demonstrates wealth to be ultimately illusory unless it is based on the principles and cyclical processes of nature. The dialogue reconciling these dichotomies will be the fundamental basis for economic transformation.

(Hawken 1993, p. 10)

interventions. The alternative is for their convergence to emerge as an eventual response to system collapse.

Indeed, the solution lies in changing the objective function of our activities and then optimizing them, coupled with better resource cycling (Henning 1998; Mallet 1991). Recent developments in "industrial ecology" (Tibbs 1992) can help this process over the shorter term, but fundamental system redesign will be required over the longer term. Industrial ecology is evolving beyond mere efficiency changes and "end of the pipe" solutions in industrial processes and production and waste management to waste elimination by linking industrial systems to ecosystem principles. It is increasingly recognizing the crucial connections between the structure of ecosystems and the structure of other systems (both natural and human). Industrial ecology means designing for the environment, integrating the design of production systems technology with closed loop manufacturing. New processes and new products is what industrial ecology is all about, merging ecological principles with industrial practices, taking the basic principles of nature, and integrally incorporating them into the front-end of industrial production and processes. For example, nature produces no waste, essentially because waste is transformed and used by something else, either through symbiosis or mutualist relationships (Odum 1975).

Over the long-term, the ecological and economic imperatives converge with respect to competitive advantage. It is clear from industrialized countries, that as the costs of materials and of waste treatment continue to mount, it can become a competitive advantage to use less virgin material, to consume less energy and to produce less waste. For example, Germany has legislated that its automobile manufacturers must now take back their product at the end of the life cycle, essentially mandating a simulated negative feedback loop. Canada's international competitiveness will be affected by its ability to move from basic efficiency measures, to substitution measures such as clean, green technologies and technological systems, to fundamental redesign (Hill and Henning 1992).

> ***We cannot continue in our present methods of using energy, managing forests, farming, protecting plant and animal species, managing urban growth and producing industrial goods.***
>
> (Schmidheiny 1992, p.11)

The efficiency-substitution-redesign framework provides another useful model for making a deeper transition to sustainable development (Hill 1998; 1985; MacRae et al 1990). Through it, a firm gradually evolves from making minor "efficiency" changes to substituting activities, then to totally rethinking and redesigning its structures, processes and procedures. Efficiency strategies involve making minor changes to current practices to increase output and reduce waste per unit of input. A substitution strategy replaces an environmentally stressful product, practice or process with a more benign one, for example, the use of biotechnology to convert a waste disposal problem into a new product-producing process. Redesign is more holistic in its approach, and its goal is to prevent environmental problems through the design and management of healthy systems based on ecological principles (Ibid, Hill and MacRae 1995).

In the efficiency stage, conventional systems are altered to reduce both consumption of resources and environmental impacts. In the substitution phase, finite and environmentally disruptive products are replaced by those that are more environmentally benign (e.g., synthetic nitrogen, fertilizers by organic sources, non-specific pesticides by biological controls, herbicides by appropriate systems of cultivation). In contrast, the redesign stage aims to avoid problems by site and time-specific design and management approaches. The farm is made more ecologically and economically diverse, resource self-reliant and self-regulating. Problems are solved at the causal level by building self-regulating mechanisms into the structure and functioning of the agroecosystem. The redesign stage is similar to those aspects of industrial ecology that attempt to mimic ecosystem processes and incorporate them into human production systems. This means moving beyond waste management to waste elimination by redesigning industrial systems modeled on ecosystem principles. Industrial ecology integrates the design of production systems technology with closed loop manufacturing. It is also a total systems design that incorporates design for the environment at the product and process levels, and practices disassembling, reuse and recycling and makes the best use of control and assessment technologies.

Numerous researchers and organizations are exploring the policy implications of reducing the energy/material throughput of so-called advanced economies. Conscious of the need for growth, particularly in the developing world, they conclude that the material intensity of consumption in industrial countries should be reduced by a factor of up to ten to accommodate it (BCSD 1993; Ekins and Jacobs 1994; Rees 1995; RMNO 1994; Schmid-Bleek, Young and Sachs 1994). Since markets do not reflect ecological reality, governments must create the necessary policy incentives to ensure that as consumption rises, the material and energy consumption falls apace.

(Wollard and Rees, in press)

Another pathway to more sustainable economic systems may lie in the dematerialization of the economy. Our ability to dematerialize, to reduce our materials and energy inputs, directly affects our competitive advantage. Canada, as a nation, already lags behind other countries, particularly Japan, which currently uses 38 percent less energy input per GDP output than any of the other industrialized countries (MacNeill 1991). Even when allowing for differences such as geography and climate, Canada remains significantly less efficient than most other industrialized countries. Canada is now facing a competitive disadvantage in some resource sectors, as its previous relative abundance of natural resources has provided few incentives, if any, for energy efficiency, never mind substitution, or redesign. It is becoming clearer and clearer to Canadians that cod fishing on the east coast, assembling automobiles in

Ontario, and clear-cut logging on the west coast are not going to be the basis of continued prosperity in these three regions of Canada, for a whole set of interconnected economic and ecological reasons.

For both economic and ecological reasons, we need to decouple human welfare from the throughput of matter and energy in our society, as well as decouple human well-being from consumption. This will require the development of values and incentives that support such changes. This will only happen, however, through the development of a national framework of sustainable development, changing the way we produce products, and changing the material and energy inputs of those products, so that both the processes and the products are sustainable, within the ecological carrying capacity, locally, regionally, nationally and internationally. Clearly, a creative balance between public policies and employing the strengths of market forces will be needed to achieve this end. As well, changing the way we produce products and changing processes are highly dependent upon new ideas and innovation, and the incentive structure for encouraging this behaviour.

Restructuring first to incorporate industrial ecology practices into businesses, large and small, as a first step towards the deeper level of fundamental redesign will require appropriate government policies to provide a consistent framework of proactive incentives for three reasons. First, structural adjustments of this magnitude cannot happen through reactive signals through markets or even through pricing signals. As discussed, most environmental amenities, indeed, all ecosystem services, are still regarded as externalities to the market and do not have a price. There is, therefore, little economic incentive to value them, and, as a result, any integrative strategies based on existing market forces will continue to ignore or undervalue environmental costs in spite of some preliminary attempts by Costanza et al. 1997. Second, there is a gridlock of perverse economic disincentives and ecologically destructive incentives that actively encourage continued exploitation of renewable and non-renewable resources and ecological services, and that run counter to sustainable development. And third, the bureaucratic inertia and current federal/provincial morass makes the required changes unlikely unless radically new incentives and policies are developed to remove the barriers to change.

Three interrelated policies exist to redirect market forces towards sustainable development in the immediate term, namely, withdrawal of ecologically damaging and economically perverse subsidies, green taxes and a basic income scheme. Both incentives are complementary and are not substitutable for political reasons. Given the current climate of deficit reduction and downsizing, obviously a significant reallocation of resources is necessary to identify the finances for changes of this magnitude. Quite often, sustainable development arguments, and particularly discussions about a basic income scheme, are arrested by the question — where would the money come from to finance such programs? As well, there are powerful vested interests to continue business as usual, and polarized debates about the existence of limits versus no limits and unrestrained growth versus no-growth do little to increase innovation and creativity towards sustainable development solutions. That is why green taxes must be considered prior to the introduction of any guaranteed annual income scheme, in order to demonstrate one way in which the latter could be financed.

The main function of green taxes is not to raise additional revenues for governments but to redirect industrial production and practices away from unsustainable development to sustainability. Their purpose is to reflect the full environmental costs of doing business, thereby providing consumers with accurate information about the true costs of their choices in the marketplace. Their intent is to immediately correct the distortions created by the free ecosystems commons and the belief that nature can endlessly absorb human impacts without cost (Hardin 1993). Most importantly, they correct the distortions created by the relentless pursuit of lower prices and reveal true costs to purchasers (Korten 1995; Jacobs 1993). Environmental disasters such as the clean-up of the Exon Valdez oil spill, therefore, would no longer contribute to an increase in GNP. Korten (1995) further recommends that such taxes be revenue-neutral, that is, every incremental dollar collected from green fees should reduce income and payroll taxes equally, starting with the lowest income brackets and moving to the highest. He estimates that the annual fees and taxes on virgin resources, emissions, fuels, products, wastes, rights and services would equal about 1.2 percent of GDP, and by shifting the tax burden from income and entrepreneurial activity to those activities that we wish to discourage, we would be able to transform the economy. Several Swedish CEOs have already asked their Prime Minister to implement some form of ecological tax reform to gain an advantage over American and Japanese companies (van Gelder 1995). In other words, Swedish industrialists believe that future international comparative advantage and competition lies in increasing dematerialization and industrial ecology practices. The necessary changes will be further stimulated by moving towards incentives, such as ecological tax reform, to encourage industries to move in these directions.

A guaranteed annual income scheme is also necessary in order to remove one of the biggest barriers to these kinds of structural changes, namely, fear about one's ability to support one's basic needs. Addressing this fear will also decouple the support of labour from business to continue business as usual, subsequently decreasing political pressure and creating some "analytical space for policy alternatives" for sustainable development to be developed and implemented. If one accepts that corporations have both economic and social responsibilities, and that institutions are embedded in civil societies and not separate from them, then corporations have an important role to play in the creation of meaningful work. Technology has the capability of supporting this by eliminating many routine tasks from the workplace, if corporations accept that they have a key role to play in civil society to create meaningful work. Technology is a double-edged sword, however, as many technologies have resulted in de-populating the workplace. As well, some analysts argue that technological breakthroughs instead of a panacea for carrying capacity deficits, actually contribute to increased environmental degradation and overshoot (Catton 1993; Hill 1998; Rees 1991; Suzuki 1995).

Given the structural adjustments now occurring through globalization, free trade, computerization, robotization and corporate concentrations, some kind of basic income is necessary to support a human transformation needed for the transition to sustainable development. There are also important questions of power and distribution and its effects on civil society. Michael Wolzar (1983) puts the issue clearly, "A radically laissez-faire economy would be like a totalitarian state, invading every other sphere, dominating every other distributive process. It would transform every social good into a commodity. This is market imperialism . . . What is at issue now is the dominance of money outside its sphere, the ability of wealthy men and women to trade in indulgences, purchase of state offices, corrupt the courts, exercise political power . . . the exercise of power belongs to the sphere of politics, while what goes on in the market should at least approximate an exchange between equals (a free exchange)".

With respect to a basic income security, Dobell (1995) refers to the notion of a minimum participation income, the foundation for which is a social contract that "assures a basic income paid as an economic return to all citizens for two reasons: first, as participants in productive social networks and active contributors to social wealth creation; and, second, as owners of the social capital, represented by social networks and community knowledge, and of the scarce natural capital, represented by the ecological commons, that together form the foundation for market activity". The importance of social networks, social wealth and women's work are not counted in our current ways of recording income and expenditures. As well, the principle of citizen ownership of natural capital is completely ignored in the settling of national accounts.

A basic income scheme could be financed through green taxes rather than using these revenues to offset taxation on income, as Hawken (1977) suggests. Further, the possibility exists that in the long run, with the convergence of economic and social imperatives such a scheme might be more cost effective than the current employment insurance scheme. The right to meaningful work would assume greater value than the right to employment insurance. Hirst (1994, p. 180)

With the population doubling sometime in the next century, and resource availability per capita dropping by one-half to three fourths over that same period, which factor of production do you think will go up in value—and which do you think will go down?

(Hawken 1997, p. 60)

argues that it is "the one reform that would make extensive associational experiments possible, since it provides a basic plank of universal income support on the basis of which large-scale experiments that lead to diversity and heterogeneity in provision might be acceptable". A comprehensive list of recommendations for moving to a more sustainable economy, is provided in Appendix P.

All of these changes must be accompanied by a corresponding change in the way we make decisions concerning what we value as a civil society. If we consider the nature of sustainable development problems, such as global warming, ozone depletion, biodiversity loss, and overpopulation, they are becoming increasingly more complex and interactive in their processes. These problems are more and more frequently caused by local human impacts on air, land and oceans that slowly accumulate to trigger sudden abrupt changes that directly affect the health and innovative capacities of people, the productivity of renewable resources and the well-being of societies everywhere. In a democratic society, there is no single right answer to these complex, interacting problems, but rather multiple realities that can only be resolved by the plurality of interests affected.

Key Economic Imperatives

1. ***use of multiple measures to provide a more robust picture of human well-being, rather than sole reliance on one measure (GDP)***
2. ***get the prices right***
3. ***elimination of ecologically damaging and economically perverse incentives***
4. ***improved peformance indicators***
5. ***move from pioneer to climax economics; the rapid growth and exploitation of new possibilities typical of the pioneer stage will give way to a state of stable maturity in which maximum amenity is obtained from minimum resources, and energy is devoted primarily to the maintenance of the current capital stock rather new growth (Ophuls 1997).***

7

Sustainable Development Imperatives

The implementation of sustainable development is the social imperative of the 21st century, requiring strong leadership by local, regional and national governments. A framework across governments is critical to their ability to provide consistent and effective leadership to other sectors of Canadian society, in order to diffuse its concepts and practices in the next decade, before irreversible thresholds are reached.

In this period between myths (Dale and Hill 1995), old belief systems are beginning to disassemble in the fragmentation and disintegration of faith in old assumptions and substantive constructs (Lincoln and Guba 1985). We are also living with dissatisfaction, a kind of quiet despair with the old solutions that no longer seem to be working quite so effectively in the face of the crises that human societies are facing everywhere. We are obviously living in a tremendous state of flux, in which current decision contexts are complex, plural, and paradoxical.

Our decision contexts are multiple, overlapping, and cultures within these contexts often make it difficult to obtain the needed information, even if individuals were predisposed to disconfirm their present beliefs (Dyckman 1981). The new myths and solutions we seek for moving toward more sustainable societies worldwide may well lie in learning to reconcile the tensions within these paradoxes, rather than denying their existence and carrying on with business as usual.

Chaos theory predicts that undampened oscillations, which our human activity systems now appear to be experiencing will proceed to extinction as a function of increasing rates of growth.
(May 1974; Schaffer and Kot 1985)

We are obviously living in massive denial of our current ecological reality, as described in Chapter 3, for we continue to degrade our current and, some analysts would argue, our future ecological capital, at an unprecedented rate and scale in order to support the dominant Eurocentric economic system.

Just as post-modernism recognized the importance of social context for human thought, the structure and processes of natural systems illustrate equally important contexts for sustainable development. Evolution, for example, did not take place in an already created physical environment that remained static and to which life then adapted. Rather, life created the physical environment we know today, gradually transforming an extremely inhospitable environment into one favoring the further extension of life (Ophuls 1977). Diverse organisms live together in an orderly fashion, interacting with their environment, and the maxim, "as the community goes, so goes the organism" expresses a fundamental law of life (Odum 1971). In spite of the sophistication of post-modern societies, current socio-political institutions in Canada (and elsewhere) appear incapable of acknowledging and incorporating this fundamental law, of recognizing the severity of the impacts of human growth on the biosphere, and the importance of taking into account the diverse interrelationships and complexity of ecological interactions.

As discussed in the preceding chapter, the paradox of growth may well be the most critical issue facing human societies in the 21st century. Growth and its causal acceptance is partly rooted in two related (although not always explicitly recognized) impressions of mainstream neoclassical economics: that there is an infinite number of resources, and that a satisfactory substitute can always be found for the role of any one of them (Ehrlich 1979), the false law of "infinite substitutability." All indicators point to continuing growth, in our own numbers, in the space we occupy, in our consumption and their subsequent impacts on our life support systems causing changes of expanding severity: including global warming, stratospheric ozone depletion, acid deposition, loss of biodiversity, and cultural breakdown.

Humans now appropriate between one-third and one-half of the present net primary production (NPP) of the biosphere (Pauley 1995; Vitousek et al. 1986). NPP is the amount of energy left after subtracting the respiration of primary producers (mostly plants) from the total amount of energy (mostly solar) that is fixed biologically. NPP provides the basis for the maintenance, growth and reproduction of all consumers and decomposers on Earth. It is the total food resources on Earth. The decoupling of humans from their environment has led us to overestimate the capacity of the planet to absorb the impacts of our activities, and to ignore another fundamental law, the "law of the minimum" or Liebig's law. This law states that whatever necessity is least abundantly available (relative to per capita requirements) sets an environment's carrying capacity. This is similar to the idea that the weakest link determines the strength of the whole chain. While it may appear that human systems are infinitely flexible and plastic, either through technological innovation or by trade enlarging the scope of application of the law of the minimum, it is now clear that the enlarged environment through globalization still has finite carrying capacity (Rees 1996).

Due to the difficulty in coming up with a measure of the relative scale, I feel that it is better to focus on the fact that we do live in a finite physical system and that as we approach important boundaries this system will send us "feedback". I picture this sort of as approaching a tree. As soon as we start running into some branches, e.g. ozone holes, changing climatic conditions, dieoff of amphibians, we had best start paying attention before we slam into the trunk.
(Rothman, Electronic Dialogue, November 12, 1996)

Some analysts argue that human society is approaching, and perhaps has already exceeded, global ecological carrying capacity, and that extensions of present rates of consumption and production, characteristic of industrialized countries, to the rest of the globe is simply not feasible (Costanza et al. 1995; Daily and Ehrlich 1996; Meadows et al. 1992; Odum 1972; Wackernagel and Rees 1996). If current population rates continue, it would appear that by the year 2030 the human species may be appropriating 80 percent of the Earth's total carrying capacity (Regier, personal communication). Indeed, in spite of the vast amounts of information now circulating, it is difficult to determine exactly where we are on the following spectrum (Figure 7.1), although most ecologists are clear that we are already well past the point of sustainable development:

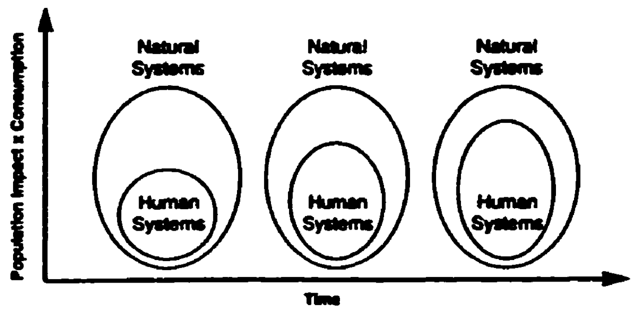


Figure 7.1. Size of human activity systems relative to natural systems

Furthermore, civil societies have not been able to successfully engage in collective dialogues about which is the preferred state, since it raises the difficult issues of population, resources, consumption, and environmental health. As well, this discussion brings into play complex issues, such as the nature of these limits and their plasticity, values, human ingenuity, and the role of technology. In addition, there are differing assumptions, perceptions, and knowledge about the importance of environmental conditions and processes in supporting human well-being, and in the sensitivity of those conditions and processes to disruption (Holdren 1995). Hardin (1986) proposes abandoning the term carrying capacity when dealing with human problems in favour of cultural capacity, defining the cultural capacity of a territory that is always smaller than its carrying capacity.

Present-day society is locked into four positive feedback loops which need to be broken: economic growth which feeds on itself, population growth which feeds on itself, technological change which feeds on itself, and a pattern of income inequality which seems to be self sustaining and which tends to spur growth in the other three areas.

(Furkiss 1974, p. 235)

Regardless of the debate over definitions, it is clear that human appropriation of carrying capacity will continue to increase unless we make some immediate changes in our values and current levels of growth. Since 1900, the world's population has multiplied more than three times. The world's economy has expanded 20 times. The consumption of fossil fuels has grown by a factor of 30, and industrial production has increased by a factor of 50. Most of this growth has taken place in just the last 40 years since 1950 (MacNeill et al. 1991). Estimates of the fraction of land on the planet transformed or degraded by humanity fall in the range of 39 to 50 percent, and by the end of this century the flow of about two-thirds of all of the Earth's rivers will be regulated (Vitousek et al. 1997).

Such numbers are clearly incompatible with ecological and evolutionary processes, including the persistence of large predators, the continuation of annual migrations of birds, speciation in large organisms, and the protection and maintenance of native biotas.

(Soule 1991)

One of the most critical resources for carrying capacity of an animal population is food, and it may well prove to be the ultimate determining factor for human societies in the future. Brown (1995) predicts that food security and distribution will become the defining focus of the global environmental threat, as seafood catch and grain production per person continue to fall, coupled with rising food prices and increasing demand for grain. In addition, a doubling of the human population size portends a more than doubling of human impacts because humanity has sequentially exploited the most accessible of its essential resources (Daily and Ehrlich 1996).

There are quite simply no new frontiers left to exploit. Boom and bust resource cycles and environmental degradation have been part of man's history since the beginning of civilization. In hunting and gathering societies, as one area's resources were diminished, humans moved to another area. With the agricultural revolution, however, people became more place-bound, and new forces, such as privatization and centralization, were introduced into human production, rapidly expanding human activity impacts on ecological carrying capacity. Exploration and conquests of New Worlds meant new markets and resource exploitation on an even greater scale. This appropriation of new frontiers gave humans the perception of being able to engage in infinite expansion and growth. As scale, time and place appeared to be transcended by our ingenuity, and as our numbers began to expand exponentially there was an imperative to intensify production, particularly agricultural production, by means of enhanced technology.

Human culture has removed the constraints that result in dampened oscillations characteristic of most other species. Human systems are presently incapable of responding to negative feedback loops even though they loom before us. The result is unregulated growth and potentially lethal population instability that degenerates to figurative, literal and mathematical chaos.

(Hern 1990)

Not only the scale, but also the nature of this growth is having profound impacts on the ecological carrying capacity of the planet (Clark 1989; Goodland and Daly 1993; Erhlich and Erhlich 1991). For example, if every Chinese person was to purchase a car, and a refrigerator using CFCs, then although as a nation they would be better off, globally it would be catastrophic in terms of global warming and ozone depletion. It would appear, therefore, that the closer we come to these ecological limits, the less we can assume that economic welfare, as generally defined today, and total welfare are moving in the same direction. Nevertheless, as Gynne Dwyer's (1997) four part CBC series, *The Population Bomb*, dramatically demonstrated, the increasing demand from less developed countries (LDC) for access to the same products that are currently consumed in so-called developed countries is inevitable. Clearly, to achieve sustainable development, the material nature of these products, and our production processes must change dramatically or be fundamentally redesigned.

The more fundamental danger is to the quality of life and to human freedom - especially personal freedom - that will follow from a course of action that presses society to extremities in the maximum utilization of resources and spaces.
(Caldwell 1970, p. 217)

Economically, the world is undergoing both massive and rapid change. Coupled with the rapid disappearance of centrally-planned economies throughout the world, there is a tidal wave of development and expanded reliance on market forces and market-based policies. There are powerful trends towards global economic integration through trade liberalization and the emergence of an international capital market, characterized by flows of capital ever in search of higher rates of return. The growth of newly industrializing countries in Asia, now including China, Indonesia, Malaysia and Thailand, and the rapid expansion of world trade, will continue to challenge the ability of all systems to maintain their integrity. Indeed, the current crises in the economies of the Asia-Pacific Rim probably indicates that the global trading system as a whole is following the boom and bust cycles of resource exploitation. Fundamentally, as argued in the preceding three chapters, social and economic imperatives can only be supported with an equal emphasis on rehabilitation and maintenance as on production, and I would further argue, enhancement of ecological systems worldwide.

Socially, we appear to be witnessing a psychopathological uncoupling and coupling occurring simultaneously. Examples of the former include the delinking of money from production, in that money has become a means to an end, independent of production. As well, we can recognize a delinking of employment and profit in many sectors. Thus, as companies become more profitable, they are laying off more and more workers. This can be seen most clearly in the banking sector. As more and more industries move into the global marketplace, there is an uncoupling of work from place. As resources are depleted in one community, companies simply move to another, leaving local governments to deal with the subsequent unemployment, social dislocation, and ecological degradation. These processes continue to create a social trap (Costanza 1987) in which population growth becomes coupled to increasing inequity, reduced carrying capacity, and unsustainable development. Because of these links, Catton (1993) argues that most of today's less developed nations will never become developed, and that this will have serious repercussions for civil societies everywhere.

The above leads us to the overwhelming conclusion that we are approaching, and in some realms may have already exceeded, the global carrying capacity of the planet. It is clear that whereas loads may grow exponentially, carrying capacity may not (Arrow 1995; Catton 1993; Rees 1996). As I have argued earlier, in Chapters 3 to 6, there is already ample evidence of system breakdowns, global climate change, ozone depletion, unprecedented rates of biodiversity loss, and inequity both within and between countries. Our species has clearly moved from a self-perpetuating way of life that relied on the circularity of natural biogeochemical processes, to a way of life that is ultimately self-terminating because of its reliance on linear chemical transformations (Catton 1993). Our current practices are clearly unsustainable, and business as usual is not an option. Sustainable development is, therefore, a strategic imperative for all nations at every level of human activity.

Critics have argued that the term sustainable development is an oxymoron and that development is being emphasized at the expense of sustainability (Jickling 1994; Lele 1991; and Rogers 1994). Much of this criticism stems in part from the fact that sustainable development touches on every sphere of human activity, technological, economic, political, and cultural, thus, bringing into play most of the dominant paradigms, myths and metaphors from these domains. In addition, the current structure of academe and government means that practitioners in the various relevant fields each only have access to a small part of the picture. They typically think in terms of different time scales, and often use the same words to mean different things (Holdren et al. 1995). Jacob (1994) argues that any sustainable development formulation must be able to meet the metatheoretical criteria that determine the ability of a framework to effectively guide research and ultimately the development of policies to achieve a given set of objectives. She further suggests that the definitional confusion surrounding the concept is not really about meaning, but about whose values should take precedence in the definition. Some analysts argue that sustainable development is not possible without cultural change, that is, a paradigm shift, and that cultural change is a feminization in the sense of emphasizing connectedness, relationships, cyclicity and nonlinearity (Malley and Lawrence 1994).

> ***The concept of optimal allocation among alternative uses of the total resource flow (throughput) must be clearly distinguished from the concept of an optimal scale of total resource flow relative to the environment. Under ideal conditions, the market can find an optimal allocation in the sense of Pareto. But the market cannot find an optimal scale any more than it can find an optimal distribution. The latter requires the addition of ethical criteria; the former requires the further addition of ecological criteria.***
>
> (Daly 1991, pp. 241-242)

Nevertheless, I believe that the strength of the concept lies in its constructive ambiguity, and that this has kept people at the table who normally do not talk to one another. I believe the term does raise the issue of growth. It is inherent, although it is not implicit. Its greatest strength may lie in its ability to transcend the old left-right classical dichotomy, and the no-growth and full-growth polarization, and to stimulate new discussions about the nature and meaning of growth in a sustainable society. As well, putting sustainable in front of development means not that development can be continued indefinitely, but rather that the choice of processes and end states for development must be compatible with maintaining the improved conditions indefinitely. A sustainable process or condition is one that can be maintained indefinitely without progressive diminution of valued qualities, both inside and outside the system in which the process operates and the condition prevails (Holdren et al. 1995).

Sustainable development, since its widespread promulgation through the 1987 Brundtland Commission Report, has brought together new coalitions, albeit some of them rather fragile; but, if these coalitions can now strengthen and begin to work together in more synergistic ways in the third sector (Rifkin 1995), we may be able to achieve more accelerating positive social changes.

I have earlier defined sustainable development as a process of reconciliation of three imperatives: (i) the ecological imperative to live within global biophysical carrying capacity and maintain biodiversity; (ii) the social imperative to ensure the development of democratic systems of governance that can effectively propagate and sustain the values that people wish to live by; and (iii) the economic imperative to ensure that basic needs are met worldwide (adapted from Dale et al. 1995). And equitable access to resources— ecological, economic and social— is fundamental to its implementation. Meeting all three sources of imperatives is both necessary and sufficient. It is counter-productive to debate which is more fundamental. Without satisfying ecological imperatives, we poison ourselves, deplete our resources and destroy the basic life support systems so necessary for human and non-human survival. Without heeding the economic imperatives, we cannot provide the necessities of life, let alone provide meaningful work, and without taking account of the social imperatives, our societies will collapse into chaos. Given the interconnectedness and nature of sustainable development, failure in any one area will make it impossible to properly address the other two, particularly over the long-term. In Appendix Q, I have provided a case study – a brief discussion of the cod fisheries collapse on the East Coast that illustrates these essential interconnections.

Like many things, the value of the sustainability journey seems to be in the journey itself rather than the destination. Even though the goal is elusive, and perhaps impossible, the challenge of responding creatively is what motivates many of us. Aiming for sustainability necessitates the re-examination of fundamental assumptions about the business we are in, the objectives we set and the way we organize ourselves. It places everything we do directly into an ecological context.

(Torrie 1996, p. 25)

But what are the characteristics of sustainable development? When considering the specific issues of global warming, ozone depletion, biodiversity loss, overpopulation and consumption, it quickly becomes clear that they are more complex and interactive than is generally assumed. These problems are more and more frequently caused by local and global human impacts on air, land and oceans that slowly accumulate to trigger sudden abrupt changes that directly affect the health and innovative capacities of people, the productivity of renewable resources (Holling 1996) and the well-being of human societies everywhere. And this increasing globalization of biophysical phenomena is interacting with the globalization of trade and the large scale movements of people (Holling 1993). The problems are ones that emerge in several places and suddenly, rather than ones that emerge only locally at a speed that is rapid enough to be noticed, but slow enough to permit considered response (Holling 1996). For example, the hole in the ozone layer had to reach a critical level before it could be detected by scientists, and then, quickly became a major problem affecting many nations and communities, including many that have not contributed to the problem. Consequently, the solution must involve all nations. The problems and the potential responses to them move both human and natural systems into such novel and unfamiliar territory that aspects of the future are not only uncertain, but are inherently unpredictable (Holling 1993). We shall never attain scientific consensus concerning the systems that are being examined, and knowledge of the system with which we deal will always be incomplete (Walters 1986, 1990). Moreover, there is also an inherent unknowability, as well as unpredictability, concerning evolving managed ecosystems and the societies with which they are linked (Holling 1993). Because of uncertainty, sustainable development issues can often be manipulated by political and economic interest groups (Costanza 1997). Because everything in ecological systems changes constantly, sustainable development is a moving target (Salwasser 1993).

Sustainable approaches stress uniqueness of time and place and of working with local natural resources and processes.
(MacRae et al. 1989, p. 177)

We must recognize that the assault on the environment cannot be effectively controlled, but must be prevented; that prevention requires the transformation of the present structure of the technosphere, bringing it into harmony with the ecosphere; that this means massively redesigning the major industrial, agricultural, energy, and transportation systems; that such a transformation of the systems of production conflicts with the short-term profit-maximizing goals that now govern investment decisions; and that, accordingly, politically suitable means must be developed that bring the public interest in long-term environmental quality to bear on these decisions.
(Commoner 1975, pp. 192-193)

Sustainable development issues are scale, place and time dependent, and must be defined according to the type, intensity and frequency of use —subject to maxims defined locally, regionally and nationally (Regier and Baskerville 1986). Concerns about precise definitions and frameworks may be spurious given the diversity of regions, both socially and geographically. Appropriate forestry practices for the West Coast of Canada, for example, are very different from those needed on the East Coast. These communities, therefore, must define the specifics of sustainable development according to their unique ecological, social and economic imperatives, and, in some cases, there may well be greater emphasis on development than sustainability, whereas in others the reverse may be true. By extension, these imperatives will also vary greatly from nation to nation, as cultural factors are inserted into the decision making process. That is why I have collapsed all the many ecological, social and economic imperatives into three relatively simple statements that I believe are the minimum means to effectively implement sustainable development. Given the above description of the characteristics of sustainable development, each socio-political bounded region will have to further elaborate their own imperatives given their context. Although those three imperatives appear deceptively simple, I believe they are sufficiently robust to ensure a more sustainable pathway. All three are therefore, necessary and sufficient conditions. They involve difficult questions of valuation, however, such as defining "basic needs."

Another key question within sustainable development involves the specification of what is to be sustained. It is, therefore, a normative concept, and it evokes strong values at societal and individual levels. Sustainable development knowledge is more value-driven, as well as more curiosity-driven, and consequently this necessitates an unprecedented interface between research and public policy, a kind of civic research. Moreover, Ludwig et al. (1993) make an important criticism of the idea of sustainable exploitation of resources: without an adequate grasp of the human dynamics that drive exploitation, there can be no adequate understanding of how it could be achieved or maintained. It is important to realize that in democratic post-modern societies, there are no single, right answers to the many complex, interacting problems. Rather, we must always be willing to work with multiple emergent realities that can only be decided by the plurality of interests affected. Sustainable development, therefore, has both highly political and social contexts.

A model that puts values at the centre of human organization is provided in Figure 7.2.

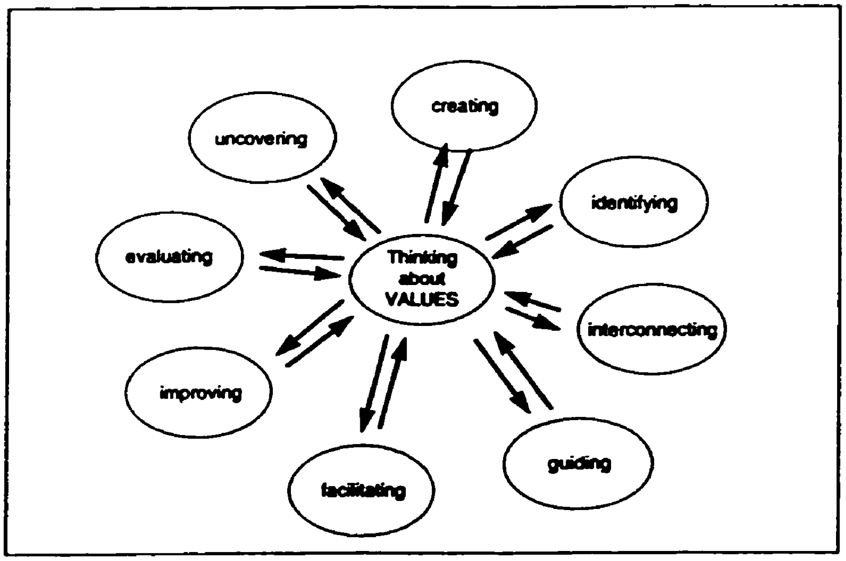


Figure 7.2. Values-based thinking (Keeney 1992)

In this model, values are put at the centre of the decision-making process, rather than denying that they can be "objectively" submerged. By making values explicit to the process, Keeney believes more meaningful consensus may be achieved. This model, when combined with Norgaard's (1994) co-evolutionary one, provides for a richer picture of human activity systems. I maintain that the separation of values from organizational life is an artificial construct, since values are inherent to human behaviour, whether or not they are explicit or implicit. Values determine how we structure our organizations, the nature of our science, the paradigms, myths and metaphors we construct to make sense of our world, our interpersonal relationships, and our relationships with the environment. Putting values at the forefront then, is similar to exposing our dominant paradigms, as it encourages debate and discussion about their applicability vis-a-vis current realities. Since sustainable development is a normative concept, values and their articulation are key to any discussions about a common framework (Hill 1978 and 1991; Schumacher 1977; Science Council of Canada 1977).

Because of the complexity and interlocking nature of the systems involved, interdisciplinarity will be a fundamental necessity for both decision-making and finding sustainable development solutions to problems such as global warming. Indeed, a major element in the lack of progress in implementing sustainable development may well be the historical separation of knowledge which divided the biological and social sciences, and the resultant distrust of biological analogies by most social scientists (Caldwell 1969).

A critical distinction, however, must be made between multidisciplinary, interdisciplinary and transdisciplinary research. The former usually consists of different disciplines investigating the same topic, but still adhering to their traditional disciplinary languages and concepts. If integration is attempted, it is frequently an add-on to the traditional separate disciplinary approach. In contrast, interdisciplinary and transdisciplinary research implies that there is some common conceptual or systemic framework that undergrids the entire research framework. It requires the conscious searching for unifying and holistic concepts that foster and reinforce understanding across disciplines. Integration among disciplines occurs in the design and conduct of the study.

Formal research, experimentation, and testing, that is, systematic observation, theory-forming, and experimentation as a scientific activity, are needed to produce generic knowledge, but they are not always needed for problem solving. The challenge of sustainable development increasingly presents itself as a problem-solving activity. It is also about the production of useful knowledge, that is, it is inherently applied research. As well, it is normative and not value-free, and it involves complex issues of polity and culture. The nature of sustainable development issues requires at all levels more expanded decision and research contexts.

It seems that in an adaptive and resilient management and decision-making model for sustainable development, we need expertise that has co-evolved out of place, culture and tradition, which is every bit as important as the acquisition of new knowledge in disciplinary expertise. In this sensibility, "expertise" that is adaptive and resilient is diverse—it incorporates local wisdom, traditional knowledge, understanding of history, context, place and scale.

(Lister, Electronic Dialogue, July 11, 1997)

A systems perspective is also critical, since sustainable development issues require us to deal with complex personal, social and ecological systems. Systems thinking provides a framework for interrelationships rather than things, for seeing patterns rather than static snapshots. I have provided a more detailed discussion of systems thinking in Appendix R. Some of the principles governing natural systems are holism, interdependence and interrelationship. Just as all the properties of water are not predictable from the properties of oxygen and hydrogen, so the properties of ecological systems are not predictable by studying the properties of the living entities and non-living matter of which they are composed. The classical duality between the living and the non-living does not exist in natural systems and, indeed, as it is argued in Chapter 5 on social imperatives, that this is one of the pervasive old myths that must be changed. As also argued earlier, habits of

It may be by accepting the notion of biophysical limits, coupled with the idea of carrying capacity, at different scales, locally, regionally, nationally and globally may go some way, as Dale (Rothman) suggested. I disagree, however, that we should wait until we approach critical boundaries, because of threshold effects leading to collapse, foreclosing future options. As well, given the increasing interlocutory effects, and our inability to respond to negative feedback loops until we reach or near critical thresholds, there must be a better way, given human ingenuity and innovation. I believe that Vitousek's work could become a powerful metaphor, coupled with the concept of limits to the biosphere for getting people to look at their position within the world they inhabit, and the room they are leaving for the "others".

(Dale, Electronic Dialogue, November 17, 1996) thought tend to be extremely persistent, and mainstream thought, by definition, excludes consideration of alternatives. This and other related barriers will be examined in the next chapter.

Most importantly, knowledge experts from every domain have to realize, accept and plan for the fact that knowledge of the systems they are dealing with is, and always will be, incomplete. Surprise is inevitable, and thus, there will rarely be unanimity of agreement among peers, only an increasingly credible line of tested argument (Holling 1996). Indeed, this lack of unanimity will be used by competing vested interests as an argument for maintaining the status quo. Moreover, not only is the science incomplete, the system itself is a moving target, continually evolving because of the impacts of management and the progressive expansion of the scale of human influence on the biosphere (Ibid). This incomplete knowledge is partly the result of the uniqueness of interactions in space and time, and of the evolving nature of the relationships between natural and human activity systems, especially given the dominance of the human species in ecosystems everywhere.

> ***The most basic idea of ecology is that of a "system". The practical implication of an ecological system is just this: we can never do merely one thing. Living things are all a part of a "web of life", and we cannot touch a single species without tugging at relational strands extending in all directions.***
>
> (Hardin 1969, p. 152)

In addition to the need for interdisciplinarity and transdisciplinarity, is the need for human activity systems to recognize and understand the interdependence of ecological systems. Everything within any ecosystem can be shown to be related, most indirectly, to everything else. Moreover, there are no linear relationships; every effect is also a cause in the web of natural interdependency. Of course, not all relationships are equally important or equally sensitive, and most operate slowly, indirectly, over the long-term and non-linear ways. In general, however, interdependence is total (Bookchin 1992; Commoner 1975; Folke and Berkes 1992; Hardin 1993; Henderson 1991; Hill 1981; 1991; Holling 1992; Leopold 1949; Jantsch and Waddington 1976; and Odum 1973). Thus, the biosphere is a unity and can only be understood in terms of itself (Daly 1994; Ophuls 1977; and Odum 1971). Systems thinking requires, therefore, the ability to work with both the parts and the whole, for they are nested realities of one another, as Koestler's work (1978) on holons and Smuts (1926) work on holism argue.

Systems thinking is about relationships and interrelationships between the parts and the whole. Studying structure is one method of understanding a system in a way that permits many other things to be related and understood. Another way is through the transfer of principles and attitudes. A third approach is by examining the underlying principles and ideas. Understanding structure, transfer of principles and attitudes and understanding underlying principles and ideas of natural and ecological systems, I will argue in the following chapters, is critical for promulgating sustainable development practices throughout society.

Sustainable development is as much of a revolution, at the redesign stage (Hill 1985; 1996; 1998), as was the industrial revolution of the eighteenth century. Modern society, however, is much more sophisticated, complex, and institutionally organized than eighteenth century society. Many barriers at the individual, intra-organizational, inter-organizational and societal levels work against major change. If change occurs, it is often piece-meal and incremental at best. Innovation, defined by Kanter (1983) as the generation, acceptance, and implementation of new ideas, processes, products, or services, and by others as a process of political and social change, is key to ensuring the transition to sustainable development. Clearly, integrative innovation-stimulating cultures (Ibid, 1983) in industry and governments are a prerequisite for realizing change of the magnitude that sustainable development requires, if it is to be integrated into all levels of Canadian society.

Robinson (1992, 1991, 1990, 1988) has argued that the "dragnet" view of science be replaced by a model relationship in which researchers, policy makers, and the public form "mutual learning systems" that use modeling tools to explore alternative futures (backcasting) rather than trying to predict the future (forecasting). Elements of this model include the explicit recognition that policy questions are not essentially questions of fact but value, and that both a "physical flows" perspective and an "actor-system" perspective are needed to provide a usefully integrated approach to policy questions.

It is only when we open our minds to the paradoxes of sustainable development and the possibilities of new paradigms, myths and metaphors that we will be able to realize its implementation. Some of these paradoxes are concerned with how to retain and develop local self-reliance in the face of increasing globalization; equity between present and future generations; equity between the North and the South; a balance between the competing forces of centralization and decentralization; a balance between diversity and the potential for increasing homogenization as a result of globalization; and a balance between the space we occupy and the space we leave for other species. These paradoxes will not be resolved without an explication of differing individual and cultural values, preferences, as well as beliefs about and approaches to a highly uncertain and unknowable future, and the resolution of such differences through supportive social processes (Holdren et al. 1995). This, I will argue in succeeding chapters must include expanded decision-making contexts, especially by governments.

Human culture has removed the constraints that result in dampened oscillations characteristic of most species. We have not yet recongnized or acknowledged any negative feedback loops that seriously endanger our survival as a species even though they loom before us. The result is unregulated growth and potentially lethal population instability that degenerates to figurative, literal and mathematical chaos.

(Hern, 1990)

8

Restraining and Driving Forces

Suppose you own a pond on which a water lily is growing. The lily plant doubles in size each day. If the lily were allowed to grow unchecked, it would completely cover the pond in 30 days, choking off the other forms of life in the water. For a long time the lily plant seems small, and so you decide not to worry about cutting it back until it covers half the pond. On what day will that be? On the twenty-ninth day, of course. You have one day to save your pond.

(Meadows et al, 1983, p. 29)

In spite of the overwhelming ecological evidence that we are destroying the very natural resource life-support systems that form the basis for human viability, there has been a systemic failure on the part of human activity systems to meaningfully and effectively implement sustainable development policies and practices. A central question we have to ask is, why in the face of this overwhelming evidence has there been this systemic failure to address the sustainable development imperative. What would appear to be systems based on rational-expert decision-making models may, indeed, be supporting and perpetuating decision-making that is based on ill-founded conceptions of natural systems (Appendix M) and inherent psychopathological structures, supported by out-dated paradigms, metaphors and myths (discussed earlier in Chapter 3). I maintain that these structures are continually maintained and reinforced by a variety of vested interests that are committed to perpetuating the status quo or extrapolations of it, with its existing distribution of power and access to resources and rewards. In addition, the failure to address the underlying nature of unsustainable policy choices arise from deeper assumptions about how the world works. These assumptions, which actually comprise our worldviews or mental models (Bateson 1972; Boulding 1981; Capra 1991; Kuhn 1962; Lincoln and Guba 1985; Maturana and Varela 1987; Reason 1981 and Rowan 1976), although rarely stated, as discussed in Chapter 4, are detectable as metaphors and implied beliefs. In that chapter, I also examined two restraining causes for effective action, the pervasiveness and persistence of dualistic thought in EuroAmerican systems, and the dominance of prevailing paradigms, myths and metaphors. In this chapter, I will examine those features of institutional behaviour at the federal level that contribute to this paralysis of innovation and gridlock around the implementation of sustainable development.

When swimming, I am often struck by the fact that when one works with the water, one seems to slice effortlessly through. Other times, when working against the water, it is as if one has to punch one's way through.

Over the course of my 22 years of experience as a public servant at the federal level, I have had a number of interesting and challenging assignments. Upon joining the Government in February 1976, I worked mainly on strategic policy development and machinery of government issues, such as wage and price controls, program reviews of personnel management systems, regulatory reform, environmental programs and strategies for macro-level changes in federal governance. As well, at the beginning of the 1970s, I worked on futurist research, at which time two seminal books came to influence my thinking and subsequent career choices, the Club of Rome's *Limits to Growth* (Meadows et al. 1972) and Schumacher's (1973) *Small is Beautiful.* As my experience grew in the start-up of new organizations and the management of change in federal systems, I participated in building two novel programs and their institutional structures: the diversification of regional economic development programs and the establishment of the Atlantic Canada Opportunities Agency, and, more recently, the creation of the National Round Table on the Environment and the Economy (NRTEE). Since October 1988, I have been working exclusively in the area of sustainable development policy and planning, and since 1993, as a Senior Research Associate with the Sustainable Development Research Institute at the University of British Columbia and with the Canadian Biodiversity Institute, in Ottawa.

> ***People in organizations, including educational organizations, find themselves hard pressed either to find actual instances of these rational practices or to find rationalized practices whose outcomes have been as beneficent as predicted, or to feel that these rational occasions explain much of what goes on within the organization.***
> (Weick, 1976, p. 10)

Over the past two decades, I have directly experienced and observed the difficulties of effecting change in large bureaucracies, in spite of the political will to do so, and of seemingly rational information indicating the necessity for such change. Inertia in bureaucracies and their tendency to change incrementally has been written about extensively (Aucoin 1972; Doern & Conway 1994; Kent 1988; Kernaghan & Willms 1971; Lowry and Carpenter 1984). In my experience, the forces against change appear to be much more systemic, pervasive and multi-faceted than is normally appreciated, and they operate at both the group and individual levels. In many of the Task Forces, Commissions and senior management meetings in which I have participated, I have found that often the lowest common denominator prevails in decision-making, in the face of information to the contrary. Early in my career, I started to question the expert-rational decision model, as I experienced first-hand irrational decision-making. Increasingly I noticed that issues of power and control, as well as individual psychodynamics, were key features of decision-making, and that they operated at all levels within the system.

Although aware of the pervasive influences of early socialization on childhood development and learning (Bandura et al. 1965; Issacs 1946; Kagan 1958; Piaget 1953; and Sears et al. 1957), I was puzzled by the seeming inability of bureaucracies to both appreciate the influence of their collective culture on their grasp of the reality of emerging phenomena and new information, and to respond to these changing realities. There were clearly significant gaps between rhetoric and action. I began to perceive the influence of prevailing paradigms, myths and the metaphors that surrounded us, and of the powerful vested interests committed to maintaining the status quo, or extrapolations of it. For example, the virulent opposition to and criticisms of the concept of limits introduced by the Club of Rome's 1972 document seemed out of proportion to the important ideas that were being raised. Growth and development were so firmly linked with the notion of human progress that to propose otherwise was viewed as sacrilegious. Another example is the lack of action resulting from the McDonald Commission Task Force on the Economy in 1985. At that time, the Commission stated, "In many other places in this Report, we call for less government intervention; in the area of environmental regulation, however, we are obliged to call for more. Over the long term, the task of environmental regulation promises to be immense. We shall have to deal with growth in the number and size of projects that may adversely affect the environment, with an increasing number of pollutants and hazards, with the irreversible, and sometimes unquantifiable, effects of a growing range of industrial substances and processes, and with the emerging international aspects of our environmental responsibility. Consequently, we [the Commission] recommend that governments increase their spending to provide the analytical resources needed to support the long-term regulatory task. We further recommend that federal environmental processes be brought into greater harmony" (MacDonald Commission Report, 1985, pp. 439-440). In this case, the Commission was one of the best organized task forces in the Federal Government, with an extensive research budget, and some of the best economic minds in the country were brought together. Yet, most of its recommendations were not implemented. It is revealing that its recommendations on free trade, which the Commission had linked to the implementation of a guaranteed annual income scheme to ease the transition period of structural adjustment that would occur, were

It is more appropriate to think of resources as managing humans than the converse: the large and more immediate are prospects for gain, the greater the political power that is used to facilitate unlimited exploitation. The classic illustrations are gold rushes. Where large and immediate gains are in prospect, politicians and governments tend to ally themselves with special interest groups in order to facilitate the exploitation.

(Ludwig et al. 1993, p. 35)

Anti -environmental industrial associations have a policy of combating any legislation or program that can affect their current way of doing business. Such associations carry out extensive and intensive lobbying to maintain the current status of affairs. What research they do is directed at revealing the inadequacies of proposals made by environmentalists.

(Ackoff 1974, p. 176)

implemented without the latter. It seemed clear to me that government policies were being derived from fundamental and often unstated assumptions and values concerning the nature of the world and how it works.

The increasingly plural nature of Canadian society, combined with the increase in vested interests (Anderson 1970; Banting 1986; Cairns 1988; Fox 1979; Pal 1990; Pross 1992; Raynor and Perla 1987; and Thompson and Stanbury 1984) around maintaining the status quo, results in a lack of political will at all government levels, which is accentuated at the top of the pyramid, the federal level. In a world dominated by competing vested interests, the future is inevitably contentious (Atkinson 1991). The resources of these vested interests vary greatly. In 1985-86, for example, the Social Sciences Federation of Canada budgeted over $300,000 for representing the concerns of it members; the Consumers' Association in 1980 had revenues of $1.7 million. In contrast, the Canadian Nuclear Association budgeted $4,260,000 in 1988 for its public information program (Pross 1992). Client capture works two-ways at the official level. Departments capture groups, as for example, in 1986-87, 17 federal departments paid $184,995,000 to over 500 groups (Finkle et al. 1994). Conversely groups capture the departments, in that the same organizations, once funded, tend to get funded over and over again.

It is obvious that radical changes are urgently needed in the structure and processes of public service systems of administration, which were originally established to exploit and export natural resources as efficiently and as quickly as possible, not to sustain them. The preceding chapters have argued that Canadian society, indeed, societies everywhere, are facing a concurrent decline in ecological, social and economic capital and, hence, the importance of creating incentives for people and economies to act more in harmony than in conflict with essential processes that control the dynamics and structure of ecosystems, within which biodiversity is key to their health and productivity (Folke et al. 1996; Kay and Schneider 1994; Kellert and Wilson 1993; Odum 1985; Wilson 1992; and Woodley et al. 1993). These three types of capital – ecological, social and economic – are interdependent and, because of scale and time effects, they lock us into a co-evolutionary spiral that can just as easily be negative and degenerative as positive and creative. Economic growth, total material consumption and environmental degradation are now tightly coupled in complex systems of local and global unsustainability.

Ideas, however, are not isolated from corresponding values and beliefs of the times from which they emerge, and most of these concepts have not successfully engaged current political agendas. Nor have they been systematically addressed by many academics, researchers and government policy-makers, and some alternative models such as steady-state and ecological economics have been studiously ignored. This poses a number of interesting

> ***Intellectual boundaries create the myriad specialisms that are then grouped into multitudes of human organizations. Arrangements for governance over provinces and districts or other spatially defined regions, in Canada consist of a rich overlay of elected political bodies, special purpose administrative agencies, corporations, and other non-government organizations. Their collectible abilities to analyze details and manage within artificial boundaries are not matched by comparable abilities to synthesize data into knowledge that extends across many of these same boundaries, as an understanding of systems requires.***
>
> (Francis and Lerner 1995, pp. 149-150)

questions. Why have the dominant theories and models never been seriously challenged by alternative modes of thinking? Are these concepts incapable of critical defense? Why, in the light of growing evidence of increasing ecological collapse, have the dominant paradigms not been seriously engaged in addressing both alternative models and arguments? Why is there such great resistance to emergent concepts about society and the environment, such as sustainable development?

The reluctance to seriously address and reexamine current thoughts about dominant concepts and values is particularly perplexing, given the wealth of evidence of increasing social and environmental degradation. Most of our basic indicators are consistently showing that the quality of our land, air and water continues to degrade on an annual basis. Moreover, the accelerating and interactive nature of the impacts of modern industrial behaviour is becoming increasingly clear globally through such phenomena as global warming and the increasing size of the hole in the ozone layer. The systemic failure of our socio-political institutions to address what some scholars have identified as shallow versus deep sustainable development in the face of this evidence is irrational at best, and extremely short-sighted in the long-term (Hill 1998).

Equally, socio-political institutions are manifestations of the prevailing values and beliefs of the society of which they are part. Is it true that modern institutions are rarely capable of changing at rates other than incrementally, if indeed they are capable of change at all, and what are the driving and restraining forces (Lewin 1951) working for and against emergent issues such as sustainable development?

Human societies, however, are capable of sweeping change as evidenced by the great revolutions of our past, the agricultural, industrial, and technological revolutions. In the nineteenth century, the industrial revolution swept across Europe, and was adopted by society without major resistance. At that time, society was far less structured, both politically and institutionally, and thus fewer forces were capable of resisting the sweeping tide of change. Now in the twentieth century, an entire complex system of institutions and organizations present an often formidable gridlock for avoiding change. But why, in the face of overwhelming evidence that humanity may be fast approaching ecological limits or, as some scholars claim, that it may have even overshot those limits (Ehrlich and Ehrlich 1991; Meadows et al. 1992;

Postel 1989; Rees 1996) is there such institutional resistance to the new sustainable development paradigm? The probability of overshoot is increased with delays in feedback—from the fact that decision-makers do not get, or believe, or act upon information that limits have been exceeded until long after they have been exceeded (Meadows et. al 1992), as evidenced in the collapse of the Atlantic cod fishery (Appendix Q).

The sophistication of modern society and its organizational structures have inherent and interlocking dominant values and ideologies. These are tightly coupled with structural barriers that systematically reduce the ability and, indeed, the capacity of new concepts and alternative models to challenge the dominant paradigms. Often these interlocking values and ideologies are shared across institutions and between sectors. Over time, this gridlock produces an overwhelmingly inability to respond, even in the face of new information and facts that illustrate the importance of acting in the present, instead of waiting for further validation.

> *Existing technological alternatives also face relatively important barriers, because of the positive externalities developed in the existing dominant technological path. Because of the existing routines, present tasks and qualifications, and existing user-producer relationships, the diffusion of a new (sustainable) technology is rather difficult and proceeds slowly. We face a situation of competing technologies, where the existing technologies benefit from dynamic scale and learning effects, particularly important for the diffusion stage.*
>
> (Faucheax et al. 1996)

Moreover, for those working within institutions, the reinforcing nature of these driving and restraining forces for change are covert and deeply imbedded in the historical and present web of interpersonal relations, conflict and rationale; so that even newcomers are quickly influenced by the overwhelming rationale behind current day actions. What may indeed be irrational behaviour is perceived as eminently rational, because of the opacity of driving and restraining forces. It is important, therefore, to examine what these forces are, their validity in the light of current day realities, and ultimately, to address the pathological gridlock, by linking economics and ecology in decision-making (Baskerville 1997), but more than that, link them externally to institutional structures and processes and internally to personal development (Hill 1998).

To effect meaningful change, it is necessary to identify the main social and economic forces that are currently driving ecological, social and economic decline, both the proximate and underlying forces (Perrings et al. 1992) in these three areas, and to create more effective structures to provide the necessary incentives to redirect these forces. One of the main underlying forces is the overall structure of the government that results in inappropriate and ineffective government policies.

When one examines how hunting and gathering societies were organized compared with the organization of modern day society, a number of interesting trends become apparent. The latter were more holistic in contrast to the increasing trends towards dualism and separation within modern society. Moreover, modern society has placed an increasing emphasis on technology, centralization and privatization. As human scale has increased exponentially in more recent times, there has been a corresponding increase in the concentration of production and industry in urban centers (Brennan 1997), leading to an increase in privatization. The more privatized human activity systems become, the more centralization there is. More concentration of ownership results in greater privatization, all of which results in increased reliance on technology to support the scale of human activities, a positive feedback loop. Centralization leads simultaneously to extended acquisition, which leads simultaneously to increasing scale, which leads simultaneously to increasing technology, ultimately resulting in a hyperactive rhythm of global capitalism and homogenization.

When these four trends are transposed on two axes, the following pattern emerges:

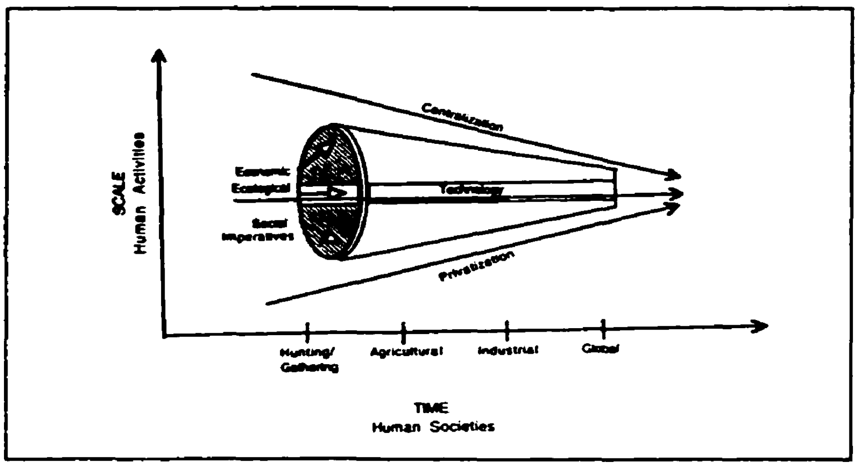


Figure 8.1 Restraining forces affecting the implementation of sustainable development

Our overall values and paradigms, such as dualistic thinking, are the forces that determine the degree of separation of the three imperatives. Moreover, centralization, our dependence on technological solutions, privatization and scale are interactive and mutually reinforcing. Furthermore, there is a positive feedback loop between these four trends. The more that ecological, social and economic imperatives diverge through disaggregate decision-making, the more these four factors converge and support unsustainable activities that will continue to lay the foundation for ecological and social collapse. Paradoxically, what appears to be increasing options through technology and scale are

Expertise almost always means narrow, specialized, disciplinary expertise; few persons by training, experience, or predilection are prepared to engage in or promote comprehensive environmental decision making. The idea of comprehensive environmental decision making finds little institutional support in the ways universities, science, or the professions generally are structured, or in the ways persons in government or business are employed.

(Vig and Kraft 1990, p. 242)

actually narrowing future options through the increasing divergence of the three imperatives.

In the absence of a guiding framework and clearly articulated principles for operating across government, this gridlock appears from within the organization as eminently rational. It explains why, on the one hand, you can have a department mandated to protect the environment and, on the other, another that actively supports unlimited or inadequately limited industrial expansion. Current economic activities are encouraged through government programs and incentives that result in continued exploitation of natural resources, with increasing capital investment and expanding scales of activity. Paradoxically, the result is increasing dependency on the continued successes of the first phase, that is, further exploitation of nature (referring back to Figure 8.2), which in the process is resulting in a loss of resilience, thus increasing the likelihood of unexpected crises and eventual system collapse. With this increasing dependency comes denial of the results of the decisions, and demands by economic interests to maintain or expand subsidies. This, along with lobby groups battling other lobby groups in their influencing of government decision-makers, results in gridlocks that make effective decision-making impossible — whether it involves salmon, owls, fishing, and logging in the Pacific Northwest, or cod, poverty and cultural survival in Newfoundland, or urbanization, wildlife and water in the Everglades (Gunderson et al. 1995). Too often decisions are made that represent the lowest common denominator among the plurality of interests competing to influence governments (decisions made to minimize disruption over the short-term).

Treasury Board President Marcel Masse has warned that governments are paying too much attention to special interest groups and risk losing touch with ordinary Canadians in shaping policies and services. He told the Association of Professional Executives yesterday that politicians and public servants must find new ways to "define" the public interest rather than letting powerful special interest groups dominate the policy-making agenda. "Special interest groups have become well-organized and their voices are heard like they're the voice of the majority...So what we have to do is find a way to consult all Canadians who are more directly involved with all issues."

(Ottawa Citizen, May 28, 1998)

Argyris (1976) maintains that existing patterns within organizations interfere with learning. He suggested that a single-loop model is the learning theory in use, but that it mitigates learning because it values control, winners and losers, suppressing negative feelings, and achieving goals defined by others. Although a double-loop model— one in which the governing values are valid information, free and informed choices, and sincere commitments—permits active learning to occur, it is not used and the conditions for its use are not usually present in organizations.

Holling and Meefe (1996), in their analysis of environmental resource management systems, identify three additional underlying factors that contribute to this pathology. First, following upon the initial successful phase (for example, insect pests are initially reduced through pesticide use), the loss of ecosystem resilience is accompanied by a shift in management agencies from their original social or economic purposes to increasing efficiencies and reducing costs. Second, their personnel become increasingly isolated from the systems being managed as their focus is politically directed from research and monitoring to corporate agendas of cost efficiencies, technologies and total quality management and apparent institutional survival. Third, one cannot underestimate the power of the externalities created to maintain the diffusion and generalization of the prevailing paradigm that constitutes a major obstacle for change, coupled with an organizational framework that supports the dominant paradigmatic thought. Exit from a particular development path, therefore, depends upon the source of self-reinforcing mechanisms. New relationships are called for and these need to be complimented by fundamental changes in government decision-making and institutional reorganization.

Expansionist pressure inherent in the economic logic or surplus production has a territorial dimension (as production is necessarily always spatial). Surplus production is thus identical to the economic conquest — exploration, development, penetration, and exploitation — of space, i.e., the 'production of space'.

(Altvater 1989, p. 68)

In addition to the restraining forces affecting the implementation of sustainable development as depicted in Figure 8.1, is the lack of a cohesive constituency, or what MacNeill (1998) refers to as the "politics of sustainable development." As he further states "Perhaps the greatest weakness of sustainable development, in my view, lies in the fact that we have not yet begun to invent a politics to go with the concept." Although the National Round Table on the Environment and the Economy may have stimulated some regime formation around the domain, perhaps a necessary precursor to developing a politic, it has yet to coalesce into a political force in Canada. The pervasiveness of "growth" in human societies as a positive and necessary social and economic good for human well-being, and its deeply embedded myths, is a main barrier to developing this new politic. Some of these myths are "to grow is to progress", "to move forward", and "to do otherwise is to go backwards". Within such a dominant socio-economic paradigm (Figure 3.1) how does one sell the concept of sustainable development, that if it is to be meaningfully implemented, means not just "doing more with less" but ultimately "doing less?" In fact, one of the reasons why the Conserver Society concept proposed by the Science Council in 1977 failed to reach the mainstream agenda was simply because many people associated "Conserver with less", and many who had survived the 1939 Depression made negative psychological associations with the conserver concept (personal commentaries).

I believe one of the main reasons a politic of sustainable development has not emerged is simply because of the fragmentation within key sectors involved in its promulgation--the development, environmental, health, peace and women's movements. What would normally be a driving force for implementation, the interest of so many stakeholders, effectively prevents an overall coalition of many interests. The problem is inherent in the nature of the beast.

Sustainable development issues are broad and horizontal, cutting across all sectors of society. As well, problem-solving and decision-making in this domain is difficult precisely because solutions are not clear-cut and future consequences of alternative actions are uncertain (Brewer 1986; Brewer and de Leon 1983; La Porte 1975). In addition, the issues are often not rationally bounded.

Hence, the stakeholders bring different perspectives, and are usually issue driven in that they hold one issue as primordial. In addition, the stakes and values are high, and thus, this very diversity may be dsyfunctional in that it leads to intense fragmentation. Even within particular issues, there can be very differing perspectives, often from a dualistic framework. For example, with respect to population, some see population in and of itself as the driving force, others see consumption as more primordial, whereas others see both population and consumption as driving forces. And to complicate matters further, there is a major geographical division, the North-South split.

And with certain issues, questions of scale also arise. For example, with respect to biodiversity conservation, experts vary greatly on whether or not to work at the habitat, populations or species level. The reconciliation of these competing perspectives, therefore, is central to the development of any coherent regime and a subsequent cohesive political force for sustainable development. The lack of a new politic for sustainable development has also been affected by a lack of consensus on what the restraining forces for implementation are and the driving forces for unsustainability.

Moreover, "just as there is no single culture, there is no single meaning of sustainable development. You cannot homogenize development, unsustainable or otherwise, in the presence of what are multiple, distinctly heterogeneous cultures and actors. Pluralism must remain the criterion of efficacy . . .The really big policy question [is] how to encourage the constructive interaction of these plural and ineradicable actors" (Thompson 1993, p. 55). It may well be that a sufficient politics for sustainable development will only emerge in those uncommon, complex moments when policies, problems and politics converge so that the problems of the moment are tangent to the politics of the moment which in turn are tangent to the policies of the moment (Roe 1998). Figures 8.3 and 10.4 hopefully provide a model for how this convergence could be facilitated by governments, that through deliberate design, avoid protracted debate over which perspective is morally superior or issue more predominant by creating semi-permanent coalitions. With attendant resources, coalitions have the opportunity to develop more cohesive civil society constituencies around sustainable development.

Although there is a lack of a politic for sustainable development, there is no lack of politics in its decision-making, for this domain is inherently more political, once again, because it cuts across across all sectors, thereby involving more interest groups, industry associations and lobbyists, and because it is normative. And since government decision-making is largely incremental, due mainly to its hierarchical and vertical structuring, decision-making is also largely incremental, and analysis sharply limited to alternatives that differ very little from the status quo. Policy is made iteratively, by trial and error, with minimal reliance on theoretical knowledge.

It is particularly disturbing that the two institutions that need to provide leadership in the promulgation and rapid diffusion of sustainable development knowledge and implementation, university and government, have underlying inherent structures that work against this. In the former, disciplinary organization and corresponding incentive structures work against interdisciplinary knowledge and research (Bowers 1997; Wright et al. 1993). In the latter, the parallel sectoral, vertical solitudes (the silo mentality) (Bougeron 1996; Osbourne and Gaebler 1993; Sutherland and Doern 1985; Zussman and Jabes 1989) similarly works against the implementation of cross-cutting, horizontal policies and practices, such as sustainable development. Moreover, Mintzberg et al. (1996) argue that the real barriers to horizontal collaboration may well be vertical, in two ways. First, the very things that enable people to be promoted in a vertical hierarchy may impede them from encouraging horizontal collaboration. For example, in the public service executives are often promoted for their loyalty to their Minister and the subsequent protection of departmental mandates. In academic institutions, the very characteristic of a good researcher, strong adherence to individual perspectives, mitigates against interdisciplinary research. Second, people at the top of the apex may see collaboration that is initiated informally in the interests of realizing the organization's goals, as suspect. Indeed, often new organizational initiatives that work horizontally, such as the Atlantic Canada Opportunities Agency and the National Round Table on the Environment and the Economy, are seen as threats to the existing departmental mandates simply by their mere creation.

For example, in analyzing 12 selected key institutions of advanced western industrial societies at the macro, meso, micro and socio-cultural levels, Perlmutter & Trist (1986) discovered that a fundamental mismatch existed, between many of their inherent structures and processes and the demands of the new environments that paradoxically they had configured. In other words, the original context in which these institutions had been created had changed so much, that their current mandate was no longer relevant in modern society. For example, given the exponential growth in human populations, a family allowance scheme may no longer be appropriate. Furthermore, since the kind of dysfunctionality they found is not readily reversible under the prevailing dominant socio-economic paradigm, it is likely to persist as long as this fragmented paradigm remains the guiding framework for advanced industrial societies. Moreover, since this dysfunctionality emerges from the interplay of extremely powerful dynamic forces, it can be expected to increase, as shown in Figure 8.1. Thus, the dominant paradigms of both academe and the federal government collude in maintaining a gridlock that emphasizes small, incremental, maladaptive actions designed not to challenge the status quo.

Institutional failure at the macro level can be readily recognized by Holling's ecosystem model in Chapter 4 (Figure 4.1). For example, overlaying the policy processes (Gunderson et al. 1995), an analysis of the decisions of successive governments with respect to East Coast fisheries issues confirms the trends discussed below and illustrated in Figure

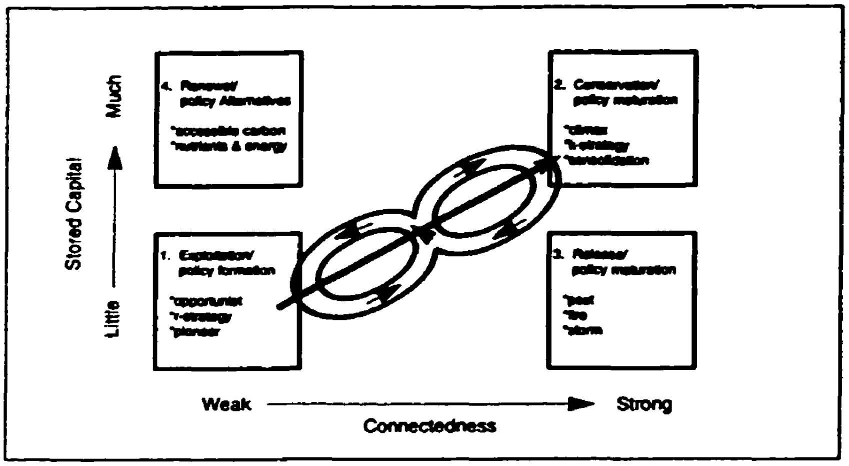


Figure 8.2 Federal government gridlock (modified from Holling 1986, and Gunderson et al. 1995)

8.2, particularly with respect to research and monitoring issues (Ottawa Citizen, July 4, 1997; November 16, 1997; December 10, 1997).

Government institutions are "stuck" along the one axis, which keeps them endlessly cycling between the exploitative and conservation phases, and this prevents them from seriously considering the alternatives. Consequently, there is never any analytical or policy space to investigate and develop the alternatives, as doing this would be incompatible with the short-term vested self-interests of business, governments, and even academe, which is increasingly driven by a colonizing granting system. When one is stuck in a spiraling pattern of exploitation and conservation, systemic learning cannot take place, and reactive rather than proactive policy choices become the norm. Because failure (which is necessary for learning) is anathematical to bureaucratic organizations designed to protect only positive images of its political leaders, responses to crises only cause government systems to flip back to the exploitative stage. Unless this underlying structural conflict (Fritz 1996) is recognized and addressed, only incremental change and implementation at the margins will be tolerated. Over time, these flips between conservation and exploitation will occur faster and faster (Regier 1995), and government policy development will become increasingly myopic and rigid (Holling 1995), further alienating our politicians from the publics they are supposed to serve, paradoxically further decreasing the very social capital upon which the integrity of governance depends.

When bureaucracies are faced with complex ecological systems characterized by complex interactions, masses of information that often seems contradictory, millions of species, as well as unknown phenomena, and risks beyond their control, they tend to first focus on those phenomena and cause/effect relations that conform to their decision-making structures and their dominant paradigms. This tendency to maintain apparent control by selecting only those variables that correspond to their 'perceived rationality' serves to affirm the need for their institutional existence and its maintenance. Deep inquiry and cause-seeking behaviour, if it occurs at all, is restricted to the boundaries of their rational and physical domain, and each piece of new information and every selected task supports a monolithic authority network of centralized and decontextualized decision-making (Edwards and Regier 1981). In addition to powerful external vested interests committed to maintaining the status quo, there are equally powerful internal vested interests, and together these create a pervasive gridlock of resistance to all alternative paradigms and policy initiatives. In the case of the environment, these restraining forces against change have enormous repercussions at many levels, ultimately threatening the very survival of our own species.

The family is a cybernetic system of the sort which I am discussing and usually when systemic pathology occurs, the members blame each other, or sometimes themselves. But the truth of the matter is that both these alternatives are fundamentally arrogant. Either alternative assumes that the individual human being has total power over the system of which he or she is a part.

Even within the individual human being, control is limited. We can in some degree set ourselves to learn even such abstract characteristics as arrogance or humility, but we are not by any means the captains of our souls.

(Bateson 1972, p. 444)

How, then, can the federal government transform itself from our current trajectory of increasingly degraded brittle ecosystems, rigid management, and dependent societies leading to crises (Gunderson et al. 1995). How can the Government become a relevant instrument for this magnitude of social change required to become a sustainable Canadian society for the 21st century? How can the federal government reconcile the competing vested interests in an increasingly plural society, as well competing paradigms and conceptual frameworks?

Integration of ecological, social and economic imperatives requires changes in attitudes, structures and behaviour at both societal and personal levels. These changes cannot be imposed, or even effectively fostered through consultation; rather, they must be sought through the collaborative efforts of all involved (Gibson and Tomalty 1995). In addition, a comprehensive understanding of linked natural and human activity systems requires the synthesis of a number of mutually supportive conceptual frameworks. These include participatory action research and collaborative inquiry (Freire 1970; Heron 1981; Reason and Hawken 1988; Reason and Rowan 1981; Torbert 1991) strategic questioning (Peavy 1986), soft systems methodologies (Checkland 1981; Checkland and Scholes 1990; Churchman 1979; Meadows et al. 1972), self-organizing properties (Kay 1994; Odum 1983; von Bertalanffy 1968), ecosystem properties (Holling 1986; Kay and Francis 1995; Odum 1989; Regier 1995; Ulanowicz 1986), co-evolutionary models (Bateson 1979; Gruen 1986; Harries-Jones 1995; Hill 1980; Jantsch 1980; Norgaard 1994; Rosak 1995, and Smuts 1976); values-based thinking (Hill 1978; Keeley 1992; Keeney 1996; and Orr 1994), as well as multistakeholder processes (Dale 1995).

In addition, as discussed in Chapters 2 and 7, interdisciplinarity and transdisciplinarity, as well as integrated modes of inquiry are required for really understanding sustainable development. This is because competence in this area can never be based on complete knowledge, but must rely on best available information and expertise, intuition, responsible experimentation and common sense. This interdisciplinarity must necessarily integrate the various disciplines within both the natural and social sciences, given the complex interactions between environmental and social systems, and particularly the current difficulty of reconciling social and ecological imperatives. It should be noted that whereas many ecological imperatives relate to absolutes, such as each species' specific needs for food and space, social imperatives are relative and much more flexible. Although it may not be apparent in the short term, in the long term, ecology determines the bottom line of human systems, not economics, which eventually must conform to the former.

A helpful technique for exposing dominant thought, methodologies, prevalent paradigms and alternative opportunities is through the use of strategic questioning (Peavey 1986), as previously discussed in Chapter 2. Strategic questioning coupled with the use of holistic models can be extremely helpful in supporting responsible (and co-evolutionary) government decision-making, at both the political and bureaucratic levels, as well as within the population at large. The building of systems models, both hard and soft, can help to identify gaps in knowledge about complex systems and serve as effective planning tools for policy analysts, decision-makers and stakeholders for at least six reasons. First, they have the capability to bring research information and analysis directly to those making resource management decisions without a filter of bureaucratic interpretation. Second, they make explicit the uncertainties and difficult choices related to risks and time preferences. Third, they can expose innovative policies by making use of spatial replication allowing decision-makers to clearly see the effects of their trade-offs. Fourth, they can facilitate more flexible responses to natural and man-made surprises. Fifth, they can expose gaps in information and knowledge, leading to the development of more precise research agendas. And sixth, by creating a visual image, they can evoke an emotional response, leading to more direct action (Westley, personal communication). The use of holistic models, therefore, may be an important visual tool to enhance responsible sustainable development decision-making that involves consideration and understanding of the meaning of complex self-organizing and open systems by a wide variety of sectors. As well, this complexity necessitates greater use of integrated modes of inquiry, such as the provision and facilitation of accessible and influential multistakeholder pluralistic fora.

It is clear that the linear "one problem, one solution" approach is no longer adequate or appropriate and must be replaced by an integrated ecosystem and social system analysis that considers people as a part of, and not apart from nature (Odum 1969). Emphasis on open, self-organizing and holarchic systems (SOHO) could provide an alternative approach for changing our sense of relatedness to one based on inclusion, rather than exclusion. This approach to understanding respects the complexity of organizational forms, and considers function and change in open systems in the context of their dynamic interactions within and without their respective environments. As a result of such interactions, these systems manifest emergent properties, as in co-evolution. Uncertainty and surprise are fundamental features of such open systems (Holling 1993), as are the related ideas of flexibility, changing and fluid boundaries among system parts. SOHOs can be regarded as being arranged in nested holarchies, in which the parts are reciprocally interdependent with the whole, alternatively dependent and independent. SOHO and soft system methodologies also serve an enlarged decision-making framework able to accommodate situations in which the facts are uncertain, reality is evolving, values are in dispute, the stakes are high and decisions are urgent. Ecological systems are, indeed, dynamic, inherently uncertain, and with potential multiple futures (Holling 1996).

Governments are so fragmented and lacking in holistic systems-analysis capabilities that the task of responding to sustainable development imperatives seems overwhelming. Managers and scientists live and work in vastly different cultures and, as a result, they often view the world from very different perspectives and act on the basis of different values, both of which are limited in different ways. The meaning of potentially useful information, therefore, can diverge widely between these two groups, resulting in inaccurate communication and paralysis on the part of political decision-makers in the face of what appears to be conflicting or incomplete information. Lee (1993) has used the phrase civic science to emphasize the point that managing complex systems should be a participatory process, open to learning from errors and profiting from success. Hill (1998) has emphasized the importance of focusing not on the 'oligopic' initiatives, but on relatively small overall meaningful acts that one can guarantee to carry through to completion, and a public celebration of success to make them contagious (and also of "failures" so that we may learn from them). Functowitz and

Ravetz (1991 and 1993) have argued for a post-normal science that addresses the management of uncertainty through the democratization of knowledge via an extended, inclusive peer community, and the recognition of a multiplicity of forms of success. Since sustainable development issues involve conditions of high variability, complex interactions, and possibly cumulative effects in ways not yet well-understood, I argue that in addition to an extended scientific peer community, it requires considerably enlarged decision-making contexts. Accurate scientific information is essential, but not sufficient. As well, the normative nature of sustainable development argues for enlarged contexts for decision-making (Dale 1995).

If there is more than one 'sustainable' outcome, is the governance system that is capable of identifying alternatives better than one that identifies only one that is preferred? Is there a difference? Does it matter? I think this is related to the point that we need systems that are 'safe to fail', that have alternatives both in terms of small decisions and large outcomes. I think the governance system that fulfills these criteria is multicentric, decentralized, networked, more coordinating than managing. At the same time, I realize that because of the artificial spatial/jurisdictional boundaries that governance needs to grow outside of the bounds whose scale extends beyond the scope of localism. So maybe a 'sustainable' governance system is able to detect the right scale of issues and match it with action—either through building external or global networks, or by allowing decentralization.

(Pinter, Electronic Dialogue, September 30, 1997)

Clearly, governments can play a key role, given their overall convening power in society, in providing for and organizing atomistic sets of individual users into interactive, institutionalized, and culturally cohesive groups. These groups then acquire the ability to manage and initiate concrete actions to address the complex sustainable development issues facing 21st century civil societies everywhere. Government is the most logical leader for this role given its convening power in civil society and its greater accountability due to the electoral process, characteristics that neither business nor the non-governmental communities share.

What is now required to achieve changes in governance of the magnitude needed are principle-centered discourses that bring together many of the alternatives discussed in previous chapters, including ecology, holism, feminism, alternative models like steady-state economics, chaos theory and other emergent sources of wisdom. The following model (Figure 8.3) depicts how these pluralistic decision-making fora might be structured to enhance decision-making for sustainable development.

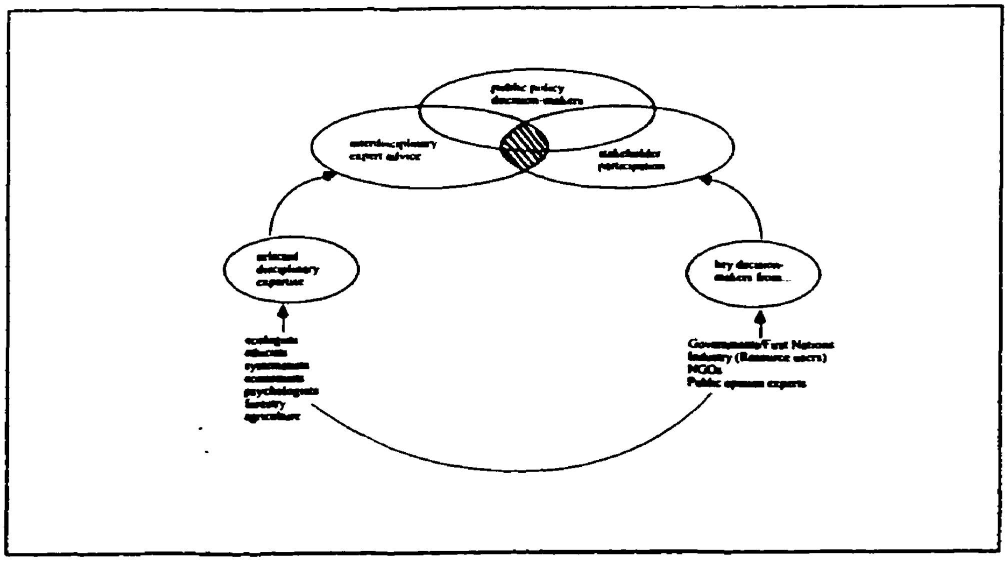


Figure 8.3 A framework to facilitate responsible decision-making (Dale and Hill 1995)

The above model represents only a first step in integrating the contributions of experts and stakeholders, who will necessarily vary depending upon the specific issue in sustainable development, with its unique time scale and place dimensions. Most importantly, it would shift public discourse toward a new centre in which the instrumental rationality of state and corporate managers is balanced by the ethical judgments and aspirations of the wider polity (Karlberg 1997).

When values and stakes are high, both ecologically and socially, then the decision stakes must be recognized as correspondingly higher for present and future generations. But, pluralistic fora cannot have all voices reflected at the table simultaneously, and most problematic are those of other species and future generations; and yet, their "interests" are where the stakes are mostly likely to be the highest. The only way to balance this inadequacy is through the widest diversity of representation possible in these fora. For example, by paying attention to gender balance, and access to power and resources, much broader (and deeper) considerations of the difficult trade-offs to be made may be achieved.

The accuracy and relevance of the information selected for examination is key to the success of these pluralistic fora, and for effective decision-making that must make meaningful trade-offs. The integrity of this information is limited by the ability of our current socio-political institutions to generate both active and responsive (and co-evolutionary) management systems that promote learning and innovation, as well as by policies that may or may not recognize that processes and products are mutually interrelated.

It is only through the interface of the three overlapping central circles in the above model that the most innovative and effective solutions for sustainable development will emerge from the sharing of new insights from several fields (Kay 1994), and that the plurality of interests will be likely to be expressed at the table. This dynamic and "untidy" interface represents the paradox of decision-making for uncertainty and surprise. The ability to live within this paradox requires individuals with the ability to transcend disciplinary perspectives, and work with the paradoxes of stability and change, of order and chaos, of sustainability and development (Holling 1989/90), of short and long-term, of near and distant, and of simplicity and complexity (Hill 1998). It requires people with the ability to transcend gaps in knowledge and information to make decisions with sometimes irreversible consequences for future generations; to simultaneously deal with the parts and the whole, and to balance the needs of our species with the needs of the many "others" with which we share this planet. Coupled with these kinds of enlarged decision-making fora is the need for a co-evolving holistic framework across government within which to formulate policies that would promulgate the principles and practices of sustainable development rapidly through Canadian society, a need that has been identified as an important challenge by a number of stakeholders (e.g., Tyrchniewicz and Wilson 1994). What is required for such a framework to be operationalized are principles for sustainable development decision-making and criteria for determining whether or not policies are supportive of sustainable development. The former is dealt with in more detail in the next chapter, and is supported by material in Appendices L, N, O and P.

> ***The dangers arising from professionalism are great, particularly from democratic societies. The directive force of reason is weakened. The leading intellects lack balance. They see this set of circumstances, or that set; but not both sets together. The task of coordination is left to those who lack either the force or the character to succeed in some definite career. In short, the specialized functions of the community are performed better and more progressively, but the generalized direction lacks vision. The progressives in detail only adds to the danger produced by the feebleness of coordination.***
>
> (Whitehead 1919)

In addition to a common framework across government, we need new institutional structures that are better equipped to deal with the broad, horizontal issues now facing Canadian society. These new institutions, however, require fundamental paradigm shifts, or at a minimum a loosening of the resistance to entertain what is currently defined as alternative thinking. Rather than tight hierarchical structures, we need diverse fora that can support the coupling of ideas for emergent innovation and creativity, especially locally. Of particular importance is re-designing our institutions so that their communities are better able to understand ecological system dynamics and respond to the early indicators of change affecting their resilience and positive functioning. If human activity systems are to be ecologically sustainable, then they need to ensure that ecosystem resilience is maintained, even though the limits on the nature and scale of their activities are inherently uncertain at the present time, and may remain so, at least in the foreseeable future. In addition, we need to reform our information systems, especially the way scientific and technological information is provided to decision-makers. In particular, we need to be able to respond to both negative and positive feedbacks from the systems, rather than ignoring them as a result of the short-term political trade-offs that are made between the three imperatives. As evidenced by the fisheries collapse (described as a case study in Appendix Q), ignoring the underlying ecological change and early indicators of ecosystem breakdown will always result in the collapse of the other two imperatives. As a start we need to loosely couple our institutional structures and introduce more organic ways of organizing, so that we can be in closer relationship with the ultimately more powerful ecological structures and functions. This is discussed in more detail in Chapter 10 (A Framework for Governance).

9

Reconciliation

The very word environment is an abstraction, one that is wrong in this context. It abstracts the environment from the person and the person from the environment. It treats the two as different. But the so-called environment is the very source of the being of the person. The human being couldn't exist without oxygen, water, food, and so on. Therefore all this really shouldn't be called an environment. It's the wrong kind of abstraction. It separates things that are one. (Bohm 1996, p. 41)

The focus of this chapter is on the need for a guiding framework across government, based on a generic definition of sustainable development, followed by strategic imperatives, out of which emerge principles for decision-making, followed by strategic objectives. The next chapter will discuss a framework for governance based on changing the boundaries of decision-making in government. This enlarged decision-making context, however, is dependent upon the implementation of a guiding framework. As the last chapters have argued, the nature of sustainable development issues means fundamentally that no one sector can address such sweeping social constructions without enlarging the scope of traditional decision-making.

Living with and acknowledging high levels of uncertainty is an essential attribute of the competency required for governing and being governed in an information society.

Living constructively and productively with uncertainty, then, will be at least as much a matter of discovering and applying new myths, values and boundaries that define the norms and processes of government as it will be one of adding more information.

(Michaels 1993, p. 84)

Through a lens informed by the values of integrity, honesty, and humility—life will go on whether we arrogant humans survive or not—we have to turn things upside down. The [ice] storm was not an attack carried out by nature on us innocent humans; it was, in a very measurable way, the result of our wasteful and ignorant lifestyles. Even the chief climatologist of Canada has linked the storm to climate change, which of course is directly linked to our reliance on the burning of vast quantities of fossil fuels, and our unchecked rapacious squandering of the forests worldwide.

(Geuer, Electronic Dialogue, January 17, 1998)

In such interdependent systems as nature-human systems, resilience in any of the ecological, social and economic imperatives is a property of the joint system. Thus, the system equilibria are a product of the dynamics of both natural and produced capital, and the stability of those equilibria are characteristic of the system (Common and Perrings 1992). The complexity of relationships within each of the three imperatives, and between them, makes it unlikely that one can predict long-term consequences of actions — particularly out of balance actions that cause, for example, extinction of other species, and arguably any other sustainable development losses. The ability of a system to absorb changes without 'breaking' down is limited, but not proportional to the perceived magnitude of the change. This realization is the foundation for my insistence that none of us can totally 'predict' or 'manage' what will or will not happen when we perturb living systems. We must pay attention to the consequences of human actions and be ready to modify them when necessary. In order to be able to respond, however, it is vitally important that decision-making systems are able to receive key ecological information and to work in meaningful ways within appropriate time frames and to modify scale where necessary. Our systems of governance now mainly respond to positive feedback loops because of the powerful vested interests that work to maintain the present system, and it consistently dampens or ignores negative feedback loops. A negative feedback loop is a chain of cause-and-effect relationships that initiates a change in one element around a circle of causation until it comes back to change that element in a direction opposite to the initial change. Whereas positive loops may generate runaway growth, negative feedback loops tend to regulate growth, to hold a system within some acceptable range, or return it to a stable state. A positive feedback loop can be a "virtuous circle," or a "vicious circle," depending upon whether the type of growth it produces is wanted or not (Meadows et. al 1992). It is my contention that a plurality of powerful vested interests work to block negative feedback information from political decision-makers and, because of their profound ecological ignorance, what is actually vicious positive feedback is interpreted as a positive social good.

What is now needed is an integrative approach, based on a fundamental reconciliation between the three imperatives in human activity systems. Reconciliation of the three imperatives is the first step leading to integration and a necessary condition for the implementation of sustainable development. Without a guiding framework and clearly articulated principles for decision-making, departments will tend to work against one another, as, for example, when energy conservation programs operate alongside the ongoing development of large-scale mega-energy projects. In addition, given the plurality of vested interests that are now influencing government decision-making, this kind of schizophrenic behaviour is exacerbated without a clearly, articulated common direction around which the bureaucracy can coordinate its various policy responses. Policy failures can

I believe that we have been fragmented by the issues, and by which sector of society was the most to blame, to little or no avail, in terms of changing of even challenging the dominant socio-economic system. We have missed the boat by concentrating on doom and gloom scenarios, that is, we have not created the new myths and metaphors necessary for diffusing sustainable development concepts and practices throughout Canadian society. And that is what I hope we will accomplish by coming up with new frameworks, and particularly, a reconciliation framework, that is dynamic, with a generic set of principles that could appeal equally across governments, the private sector and to engage the publics.

(Dale, Electronic Dialogue, June 25, 1997) often be traced to the lack of central organizing principles, ideas and methods that are mutually compatible (Byers 1991; Gunderson et al. 1995; Merton 1936; Kasperson et al. 1988; Sahl and Bernstein 1995). The vested interests for maintaining the status quo are very sophisticated at influencing government decision-making, and indeed, it is my contention, that the fragmented nature, overlap and duplication within the bureaucracy, and its current structural organization into competing sectors such as agriculture, industry, and natural resources, actively mitigates against the effective implementation of sustainable development, and it results in a policy gridlock against meaningful action.

> ***Adaptation is stressful, as many travelers who fear flying will instantly agree, and with today's rates of environmental change we are always accelerating our efforts to adapt to our own creations.***
> (Ornstein and Ehrlich 1989, p.75)

Just as ecological systems are nonlinear, and instability and uncertainty are critical elements in their change process, so too are human social systems. Nonlinear systems are evidenced by relationships between variables in which the relationship between cause and effect may not be proportionate. Thus, in nonlinear systems seemingly minor changes or disturbances may generate positive feedback, or amplifications, resulting in wholesale structural and behavioural changes. These outcomes may range from new states of equilibrium to novel states of increased complexity and organization, or even to "chaos" in which predictability and organization break down (Kiel 1991). Moreover, open systems, which characterize ecological, social and economic systems, known as dissipative structures, consist of a variety of subsystems interacting in a nonlinear fashion. Dissipative structures are continually subjected to a variety of disturbances, both from the external environment and from existing subsystems. Dissipative structures remain relatively stable to some disturbances; however, it is possible for a relatively minor disturbance to amplify existing nonlinear interactions and drive the structure to a state of extreme instability.

During this period of instability the structure may reach a critical point, referred to as a bifurcation point (Prigogine and Stengers 1984). Once the destruction of the pre-existing structure occurs, it is inherently impossible to determine in advance which direction change will take: whether the system will disintegrate into "chaos" or leap to a new more differentiated, higher level of organization (Ibid, xv). Of particular interest to government policy-makers, is the fact that it is impossible to predict the evolutionary pathway, or branch, that the system may follow at any particular bifurcation point. It is also impossible to predict the specific nature of the resulting new configuration.

> ***When human responsibility does not match the spatial, temporal, or functional scale of natural phenomena, unsustainable use of resources is likely, and it will persist until the mismatch of scales is cured.***
> (Lee 1993, p. 561)

When one considers the present interaction of natural and human activity systems, ecological, social and economic systems must be considered as evolving nonlinear systems. The relationships between their variables are dynamic, because of their increasing interdependence, their interlocutory effects, time, place and scale effects, and their co-evolutionary relationships. The continuing emphasis by human activity systems on traditional command and control management policies, prediction and centralized, hierarchical decision-making is clearly psychopathological.

The nature of sustainable development requires integrated, comprehensive decision-making, in which problems and solutions are considered with regard to their interrelated, interconnected totality. Caldwell (1963) has argued that much of the inadequacy of environmental decision-making is the fault of the predominant segmental character of policy.

So they set about, first of all, educating themselves about acid rain. They read all the scientific data. They became experts on acid rain. In the lobby business, there are no permanent friends and no permanent enemies. There are only permanent interests.

(Bowdens, Acid Rain Lobby Disbands, November 20, 1990)

Moreover, it is clear from past environmental successes, for example the acid rain and the international regime that formed around that issue, that scientific consensus and coalitions with the environmental non-governmental community are key to advancing the issues by developing consensus around a common agenda (Vig and Kraft 1990). Governments have a key role to play, therefore, in stimulating the creation of such networks of collaboration and the building of key constituencies around prioritized issues. Another example is the scientific consensus on climate change by the International Panel on Climate Change (1995), after which, at least some governments are now moving beyond the rhetoric to action on this critical issue.

The reconciliation framework I am proposing builds on the scientific consensus around the World Scientist's Warning to Humanity (1993), catalyzing action around their statement which was signed by over 100 international members of the scientific community. In addition, this framework must be holistic enough to transcend current sectoral and vested interests, since without addressing the current power and conflict issues in the Canadian polity, any applied research would be meaningless (Westley, personal communication). The framework that I will present here was developed with my co-researchers through an electronic collaborative inquiry process.

The overall criteria that we believed to be important in developing principles for sustainable development that are equally applicable across the whole of government must address the following:

1. must be easily understood,
2. be applicable in diverse contexts,

3. be transferable across space and time scales,
4. deal with individual concepts and ideas in concrete terms,
5. identify possibilities for both radical and transformative change and positive incrmental change, and
6. be regularly revisited, critically evaluated, and updated whenever appropriate (Brown, Electronic Dialogue, February 2, 1998).

Another personal criterion is that it be doable in our lifetimes (Dale, Electronic Dialogue, June 25, 1997).

In a brief review of sustainable development principles I found that most were not generic enough to transcend dominant paradigms, and they tended to be anthropocentric, or were so vague that they were meaningless. I believe that normative principles have to be constructed at a metaphysical level, a kind of metalogue (Bateson 1972), so that specific goals and objectives become an emergent property. Fundamental to this framework, based on the arguments presented in the preceding chapters, is the belief that the principles must be derived as much as possible from the structure, processes and functioning of ecological systems, and incorporated into human activity systems so that we can naturally begin to work with nature rather than against it. Most fundamentally, human activity systems are themselves embedded within natural systems, and thus the biophysical carrying capacity is an upper boundary on socio-economic carrying capacity (Daily and Ehrlich 1996). As well, values articulation was crucial to the pre-analytic development of our guiding framework.

> ***. . .is there any way to short-circuit the process, to avoid or at least shorten the periods when the system is rigid and unresponsive, maximize the periods in which the system is tuned to its environment and responding creatively. As Holling has pointed out, the ideal may be the social equivalent of the endotherm: some exchange of loss of internal variability (as long as it is associated with specific kinds of regulation), for heightened ability to explore, sense, and respond to a variety of external environments. How would the principles translate into management of change?***
>
> (Westley 1995, p. 393)

Accordingly, we propose the following guiding framework starting with the definition of sustainable development presented in Chapter 7, and building upon the World Scientist's Warning to Humanity (1993). The framework comprises a definition, 5 strategic imperatives, principles for decision-making, and 4 strategic objectives. Within this overall guiding framework, sectoral departments then define their specific goals, targets, and timetables for implementation.

Definition

Sustainable development can be regarded as a process of reconciliation of three imperatives: (i) the ecological imperative to live within global biophysical carrying capacity and maintain biodiversity; (ii) the social imperative to ensure the development of democratic systems of governance to effectively propagate and sustain the values that people wish to live by; and (iii) the economic imperative to ensure that basic needs are met worldwide. And equitable access to resources— ecological, economic and social— is fundamental to its implementation (adapted from Dale et al. 1995).

Strategic Imperatives (from World Scientists' Warning to Humanity, April 1993)
These strategic imperatives were developed by the Union of Concerned Scientists in 1993, based on their belief that human beings and the natural world were on a collision course and that fundamental changes were necessary if humanity was to avoid the collision that their present activities were bringing about. This warning has been endorsed by over 1670 scientists, including 104 Nobel laureates, representing 71 countries, including all of the 19 largest economic powers, all of the 12 most populous nations, 12 countries in Africa, 14 in Asia, 19 in Europe and 12 in Latin America. The full text of the Warning is provided in Appendix L.

1. We must bring environmentally damaging activities under control to restore and protect the integrity of the earth's systems on which we depend. We must, for example, move away from fossil fuels to more benign, inexhaustible energy sources to cut greenhouse gas emissions and the pollution of our air and water. Priority must be given to the development of energy sources matched to Third World needs—small-scale and relatively easy to implement.
We must halt deforestation, injury to and loss of agricultural land, and the loss of terrestrial and marine plant and animal species.
2. We must manage resources crucial to human welfare more effectively, giving high priority to efficient use of energy, water, and other materials, including expansion of conservation and recycling.
3. We must stabilize population. This will be possible only if all nations recognize that it requires improved social and economic conditions, and the adoption of effective, voluntary family planning.
4. We must reduce and eventually eliminate poverty.
5. We must ensure gender equality, and guarantee women control over their own reproductive decisions.

Principles for Decision-Making
These principles were an emergent property of the electronic collaborative inquiry of 20 co-researchers conducted over 2 years, from September 1996 to December 1998. Wherever possible, they represent our best attempts to develop principles for human activity systems

derived from ecological systems, although clearly some are necessary human constructs, as for example, equity.

Cyclical processes. Achieving sustainable levels of production and consumption requires the fundamental redesign of human activity systems from linear input-throughput of production processes to a redesign of those systems to closed loop operation. Inspired by the models of organisms and natural ecosystems, industrial production systems must reduce energy use and recover waste heat, and reduce, reuse, recycle materials across the life-cycle of a product; minimize entropy by designing products to limit down-cycling, and to facilitate repair, refurbishment, remanufacturing, reuse and recycling; changing the material intensity by dematerializing some activities and products by using digital instead of material consumption (Cairns, Electronic Dialogue, April 29, 1998).

> ***A lasting social advance will entail the identification of a set of nonbureaucratic principles at the domain level. These principles may be called socioecological, as contrasted with those appertaining to either bureaucratic extensionism or to self-sufficient, dissociative reductionism. Socioecological principles imply the centrality of interdependence. Entailed is some surrender of sovereignty along with considerable diffusion of power. There is no overall boss in a socioecological system, though there is order, which evolves from the mutual adjustment of the parts; who are the stakeholders.***
>
> (Trist 1983, p. 271)

Diversity is the spice of life (Rothman, Electronic Dialogue, March 20, 1998). It is an essential feature of all self-organizing systems, whether socio-economic, political, or ecological. To homogenize diversity and foster uniformity is to rob any complex system of future evolution, adaptive capacity, and ultimately of its essence (Lister, Electronic Dialogue, April 22, 1998). Consequently, functional diversity must be conserved as the basic source of system maintenance and regeneration.

Dynamic, self-organizing, open, holartic systems (SOHO) are important analogues for human decision-making; they are organic models of complex systems that occur in nature. They adapt to and accommodate change as a normal event. Such systems are diverse and flexible, and therefore resilient, i.e., they actively respond to learned experience which facilitates their adaptability, and ultimately, co-evolution. In this way, the system is able to accommodate and adapt to change, and regenerate (Lister, Electronic Dialogue, April 24, 1998). Any system, no matter how resilient, can be pushed to a 'point

> ***Diversity must also be the codeword for the way we manage ourselves. Not only shall we need to draw from a wide range of cultural and minority options to improve the quality of our lives, but also to draw upon a broad, participatory power base in our political systems to oppose and reverse present trends toward homogeneity-over-centralization, the abuse of power, and our uncaring society.***
>
> (Myers 1985, p. 254)

of no return' or to a threshold beyond which limiting factors become so severely operative that recovery, in periods meaningful in the human time-scale, becomes impossible (Dasmann and Freeman 1973).

Enlarged decision-making contexts. Decision-making for sustainable development cannot be made in isolation by any one sector of civil society, including governments. It requires new levels of integrated decision-making that bring together natural and social scientists with public policy practitioners and non-governmental organizations. Transdisciplinary fora and dialogues are needed where a multiplicity of legitimate perspectives can be expressed, and where public policy questions on sustainable development and their attendant moral, aesthetic and valuation questions can be addressed (Dale, Electronic Dialogue, April 26, 1998).

Equity must accommodate multiple and complex realities. These emerge from a globality that includes different realities of place (as in different continents), of time (as in different generations) and of form (as in different life forms). It must encompass not only the visible outcome of process, but the process itself, be it as formulated as (some) decision-making processes can be, or as unformulated as (some) aspirations can be. Ultimately, equity is about the sharing of power (Vainio-Matilla, Electronic Dialogue, March 18, 1998), and it may well be that equity cannot be actively planned for, but rather is an emergent property of functional diversity at all levels in decision-making (Dale, Electronic Dialogue, July 25, 1998).

Democracy understood as communication (Dryzek 1990) together with democratic citizenship as part of a social learning process provides some evidence that individuals can decline environmental goods and avoid or limit environmental bads. This is partly because democracy allows preferences, expectations and behaviour to be altered as a result of debate and persuasion, hiding individual behaviour to confirm the publicly agreed norms. Democratic citizenship in short permits the possibility of the voluntary creation and maintenance of an ecologically rational social-nature interaction, informed by moral as well as scientific considerations. This is because it is communicative rather than instrumental rationality which characterizes ecological rationality and the possible realization of sustainability.

(Doherty and de Deus 1996, p. 125)

Meaningful **information** for sustainable development decision-making is dependent upon integrative modes of inquiry between the natural and social sciences, as well as multiple sources and modes of evidence. Since information is constantly evolving, just as living systems constantly evolve, its integrity is vitally dependent upon the ability of human activity systems to perceive and respond to both positive and negative feedback loops, particularly in the area of policy development for natural resource management (Dale, Electronic Dialogue, April 26, 1998). Ecological information must be given at least the same weighting as social and economic information in management practices and policy decisions (Wiens 1997).

Feedback loops. Since complex systems have both changing and largely unknown natural boundaries, it is conceivable that human activity systems could badly misjudge what are the pertinent components and parameters to consider in their decision-making processes. The ability of decision-makers to be able to effectively respond to both negative and positive feedback from ecological, social and economic systems is critical to effective decision-making for sustainable development (Brown, Electronic Dialogue, August 10, 1998).

Integrity. A thing is "right" when it tends to preserve the integrity, resilience, co-evolutionary potential and beauty of natural and human systems. It is wrong when it tends otherwise (adapted from Leopold 1949) (Dale, Electronic Dialogue, August 22, 1998).

The other problem with feedback is that there are often conflicting feedbacks provided. In the case of the North Atlantic cod fishery, for example, one feedback (only detected belatedly because of the problems in the models used to assess the fishery) was the declining size of the stock. A second feedback resulted from the overcapitalization of the fishing fleet. With fortunes invested in hardware, the fishers needed large catch allowances and pressured politicians for high catch quotas. Given a population estimate with a higher degree of uncertainty associated with it (a common occurrence in assessments of natural systems) and pressure for higher catch quotas from the voters, the politicians listened to the latter feedback.

(Pope, Electronic Dialogue, November 28, 1996)

Humility. Human systems are not apart from, but rather are a part of natural systems. Life and nature are bigger and more powerful than any force that humans could ever bring to bear, and it is foolish to think it could be otherwise. Humility means seeing ourselves, our knowledge, our institutions, our systems of governance as vitally interdependent with the natural world, and recognizing our place as one among many. Rather than believing that we can manage our "environment", it means recognizing that the only thing we can manage is our behaviour and impacts within the environment. Greater sentiency implies greater responsibility rather than dominion over nature (Geuer, Electronic Dialogue, August 10, 1998).

Limits. Just as natural systems are subject to biophysical limits, all human activity systems are subject to scale. That is, the bigger they become, the more ecological space humans occupy, ultimately leading to collapse if they exceed biophysical limits. The ultimate limit on human activities is, therefore, the biosphere. Although these limits may be more plastic as a result of technology and human ingenuity, they are ultimately finite (Sims, Electronic Dialogue, August 10, 1998). Humans cannot escape the limitations imposed by the resources of the biosphere (Dasman and Freeman 1973). It may well be that the more human activity systems co-evolve with natural systems that these biophysical limits are turned into absolute human limits (Dale, Electronic Dialogue, July 21, 1998).

Multiple contexts. Human beings are context dependent. In our attempts to make sense of our world, we are heavily influenced by individual perceptions and mindscapes, dominant socio-economic paradigms and prevailing myths and metaphors. Personal and collective awareness of these multiple contexts, and our distressed tendency to maintain the status quo act as barriers to new thought, innovation and creativity. Making those tendencies explicit is key to being open to and seeking to understand new information (Dale, Electronic Dialogue, April 26, 1998).

Multiple perspectives expand our decision-making processes by bringing different kinds of knowledge to the table. This principle challenges our reliance on dominant scientific approaches that, while remaining important tools, can only provide us with a partial view of a problem and its solutions. Multiple perspectives means enlarging our ideas of who are the "experts" and what kinds of information are important. It means seeking multiple sources of observations about our natural world as well as its social and economic spheres. This process should bring to the fore the different assumptions, values and goals embodied in different perspectives (Massey, Electronic Dialogue, April 26, 1998).

Mutuality. Health and functional and meaningful existence, depends upon a faculty of the organism for mutual synthesis with others and the environment (Williamson and Pearse 1980). All human activity systems are subjectively interdependent and embedded in natural systems, and both are engaged in overall mutual and co-evolutionary processes. Both influence and are influenced by each other, often in complex and subtle ways (Dale, Electronic Dialogue, April 26, 1998).

Precautionary principle. Rather than await certainty, governments (and others) should act in anticipation of any potential environmental harm in order to prevent it. Consequently, it is essential that we become better at recognizing and responding to early indicators of system damage. Given the uncertainty and difficulty of predicting the nature of the limits of the co-evolutionary human-nature system, it would be prudent for human activity systems to live below rather than at penultimate biophysical limits. Decisions concerning the appropriate scale and nature of human activity systems, and the subsequent space our systems occupy at these limits can only be made in enlarged decision-making contexts, given the complexities involved (Dale, Electronic Dialogue, August 22, 1998).

Resilience is the ability of a system (for example, an ecosystem or a system of governance) to adapt to change while maintaining critical aspects of its original condition and function. If we wish to use the concept of resilience, we must be explicit about what aspects we value and think are important to maintain, even as conditions change (perhaps, for example, total biodiversity, democratic process, etc.) (Middleton, Electronic Dialogue, April 13, 1998)

Discursive democracy is ecologically rational, particularly from the point of view of sensitivity to feedback signals, complexity, generalizability and compliance; moreover, it promotes sensitivity to signs of disequilibrium in human-nature interactions because their sine qua non of extensive competent participation means that a wide variety of voices can be raised on behalf of a wide variety of concerns.

(Hayward 1994, p. 206)

The difficulties are so great that maladaptive defenses are becoming massively in evidence. These represent different but related forms of splitting: superficiality in which depth connection is lost; segmentation in which parts pursue their ends without reference to the whole; and dissociation in which people and groups cease to respond to each other.

Nevertheless, adaptation to complex environments is possible by appropriate value transformations. Critical are the design principles on which social institutions are built. The choice is between redundancy of parts (the machine principle) and the redundancy of functions (the organismic principle). The self-regulation and flexibility inherent in the latter give the possibility of adaptation to complexity and uncertainty.

(Vickers 1972, p. xii)

Scale. Phenomena present themselves on multiple scales. Mismatches between the scale of problem and the scale of human responses can result in inappropriate policy initiatives. We have to develop operationally acceptable ways of scanning across scales by expanding our perceptual, analytic and planning horizons, and organize our policies around the multiple scales found in natural systems (Pinter, Electronic Dialogue, April 2, 1998). Efforts must be made to adjust the scales of management to those of natural processes (Wiens 1997). The impacts of multiple scales can only be addressed through the implementation of environmental measures at a domestic jurisdictional level appropriate to the source and scope of the problem, and appropriate to effectiveness in achieving objectives (subsidiarity). Where there are significant transborder impacts, there should be international cooperative efforts (Pinter, Electronic Dialogue, April 2, 1998), as well as nested levels of decision-making (Pope, Electronic Dialogue, April 15, 1998).

A Systems **approach** is a way of trying to understand and actively learn from complexity by studying whole living systems and their interconnectedness, for example, social, economic and ecological. It is an integrated and inclusive set of approaches and associated methods for problem-solving, based on the knowledge that human and natural systems are complex, dynamic, resilient, and adaptive. The acceptance of uncertainty as an inherent quality of living systems is central to a systems approach (Lister, Electronic Dialogue, April 24, 1998).

Triangulation is the use of multiple methods, procedures and/or theories to converge on deeper understandings of what might or should be done to improve situations, given the inherent complexities that exist. We require both conventional and novel analytic methods to triangulate from as many directions as possible on what we could be doing better in the face of an issue whose empirical merits remain unknown, not agreed upon, or both (Dale, Electronic Dialogue, August 22, 1998, adapted from Roe 1998).

Values. Sustainable development is a normative and ethical concept (Robinson et al. 1989). Thus, values are central to any dialogue, policy development, planning and action. Our values are deeply embedded in our cultures of symbolism, institutions, and religions, and they collectively influence decision-making at all levels (Pinter, Electronic Dialogue, February 8, 1997). Making the plurality and diversity of values explicit through values-based thinking is critical to sustainable development dialogue, program and policy development and actions (Dale, Electronic Dialogue, April 26, 1998).

Strategic Objectives

These strategic imperatives are by no means exhaustive, but are meant to be illustrative and the minimum necessary to begin the rapid implementation of sustainable development policies, programs and practices. Moreover, I anticipate that each department would expand upon these imperatives, depending upon their particular contexts.

1. It is imperative that all government policies and planning integrate ecological information into

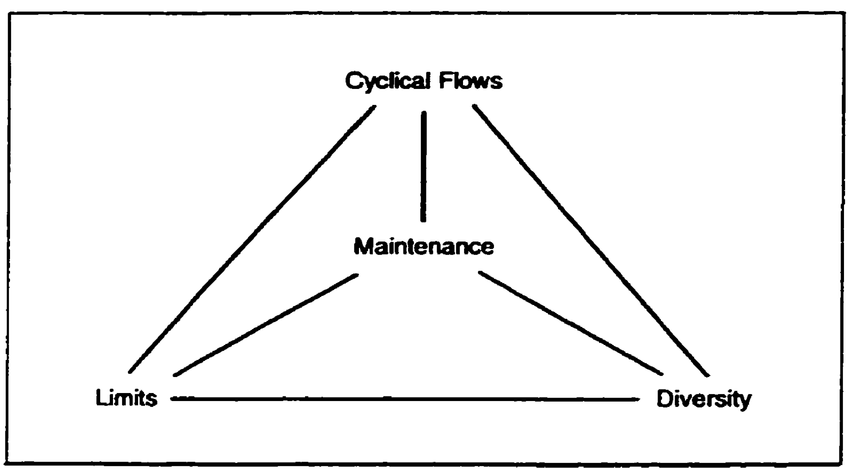


Figure 9.1 - Interrelated factors of "production/maintenance" in natural systems

the development of their programs. In order to be both more effective and minimize the likelihood of subsequent negative surprises, interrelationships in ecological systems such as cyclical flows, diversity and limits, with maintenance (as depicted in Figure 9.1) must be taken into account.

2. All government policies, planning and programs must start to replace short-term economic incentives with those that support the restoration and maintenance of ecosystem resilience, one by-product being long-term economic sustainability (Holling and Meefe 1996). This imperative also requires policies for full cost pricing, that is, transferring environmental and social costs to prices paid by firms and consumers.

An insistent message here is that the policy world—domestic and overseas—is truly multi-dimensionally complex, uncertain and plural. The sustainable development controversy, like so many others, is complex all the way down. Tightly coupled and sequential systems of policy research makes policy analysis seem much easier than it really is or could be for many controversies.

(Roe 1998,p. 9)

3. Governments must develop ways for individuals to innovate and learn and support them in doing so. An example is the application of actively adaptive environment management approaches, where policies become hypotheses and management actions become the minimal risk experiments to test those hypotheses (Holling 1978; Walters 1986; Lee 1993; Gunderson et al. 1995). Adaptive management demands that we consider a variety of plausible alternatives about the world; consider a variety of possible strategies; favour actions that are robust to uncertainties; hedge; favour actions that are informative; probe and experiment; monitor results; update assessments and modify policy accordingly; and favour actions that are reversible (Ludwig et al 1993).

4. Governments must engage people as active partners in the process of developing public policy.

5. Governments must develop local partnerships among broad constituencies so that all stand to gain or lose together from good or poor resource management (Holling and Meefe 1996); thereby enabling us to learn our way collaboratively into the future.

6. Governments must develop systems of governance that can accommodate the time, place and space phenomena of natural systems by achieving greater synergy between ecological boundaries and socio-political boundaries. An example is the ecological framework developed by two federal government departments, Environment Canada and Agriculture and Agri-Foods Canada. Based on the direction to think, act and plan in terms of ecosystems, and to move away from an emphasis on individual elements to a more comprehensive approach to monitoring and reporting on the environment, these departmments developed a nationwide ecological framework. The framework is comprised of three priority levels: ecozones, ecoregions and ecodistricts.

de Groot (1992) proposes an alternative to a reconciliation framework, a partnership with nature as an alternative worldview, as an important generator of practical ethics. "Setting relations among people and between people and nature in a single ideal of communicative response, partnership ethics are different in many ways from the ethics of rights, obligations, stewardship and intrinsic value on the one hand, and from 'Deep Ecology' metaphysics on the other" (p. 475). In his partnership ethic framework, being part of nature, not only biologically but up to the spiritual level, becomes co-constitutive for being human.

The problem with a partnership worldview is that first, in order for people to adopt such a framework, they would have to agree with its underlying values, and values have proven to be intractable in many sustainable development issues. Second, a partnership, in my opinion, must be based on equity between the partners and, once again, this raises the ongoing philosophical debate (Berry 1988; Ehrenfeld 1978; Everden 1985; Fox 1980; Livingston 1994; Peterson and Goodall 1993; Quinn 1992; Reagan and Singer 1976; Rollin 1981; and Rolston 1980) about questions of sentiency of humans and animals. This is why a reconciliation framework, based on a fundamental integration of ecological, social and economic imperatives for decision-making may be more easily accepted and implemented because of its simplicity, founded on a basic reconciliation of formerly competing interests that have brought humankind to the current level of environmental degradation. It avoids the traditional polarization and trade-offs between the three imperatives. It also argues for an extension of rationality, an extension of communicative reason, so that reason also encompasses nature, or ecological rationality (Dryzek 1990). It is a non-regressive reconciliation with nature, founded on a basic ethic of communicative action that is egalitarian, uncoerced, competent and free from delusion, deception, power and strategy (Ibid).

The adoption of a guiding reconciliation framework across government, therefore, would not be imprisoned within the dominant socio-economic paradigms and the vested interests that work to preserve them within the dominant corridors of power. Rather, it would transcend them and provide a new "rationale". This rationale could be easily communicated to the wider publics. It would consequently avoid the resultant paralysis of inaction that occurs as opposite sides use uncertainty and differing scientific perspectives to argue their case. This is not to say that values are not central to a reconciliation framework, but rather, their articulation and agreement on what is important to civil society emerges from the reconciliation process itself. As well, equity may well be an emergent property of reconciliation, if diversity is accepted as a fundamental organizing principle for civil society. Such a framework, however, must be accompanied by new ways of organizing within government, particularly with respect to policy development, to lead to appropriate actions for implementation in a timely fashion before we reach irreversible thresholds.

Policy inquiry recognizes the uncertain and tentative nature of policy "knowledge" and accepts that there may be a variety of legitimate views on policy strategies. Policy development becomes an interactive process of inquiry among experts, interested parties, and a broader public. Policy dialogue, then, becomes an occasion for exploring and discussion options. Policy inquiry can and should, now more than ever, engage the public, professional associations, business, labour and the media. In new and uncharted water—as with many issues of international development—such an approach to policy development makes eminent sense. It does not deny or exclude the reality of political motivations and political pressures; rather, it allows policy-makers to review different options and to consider options. Policy dialogue and relevant policy inquiry are the essential underpinnings of the policy leadership that can only be provided by government.

(International Development Research and Policy Task Force 1996, p. 21)

Governments adopting this guiding framework would need to have different institutional characteristics than at present in order to support sustainable development. At the end of this chapter is included a description of those characteristics, adapted from Rueggeberg and Griggs (1993) (Table 9.1). The two columns could be characterized as shallow and deep organizational change, with the left-hand column an interim transition strategy, moving to more fundamental changes on the right.

A new sense of relatedness must also permeate our institutions of governance, as redemocratization is critical in moving to the integrist model (Figure 3.3). Revitalizing democracy means restoring the moral basis of political life. We must come to deeply know that the personal is political, and that there is no real separation between the public and private spheres; to believe otherwise is due to a distortion in our lens. We need a different view of what constitutes good governance (Fukuyama 1995). Democracy is facilitated by informed and engaged publics, and trustworthy, supportive and inclusive institutions. Instead of being obsessed with controlling and doing, governments should focus more on catalyzing community empowerment by leading and by developing strategic partnerships. We must regain our capacity for release, innovation and reorganization (Figure 8.2), and we must re-integrate these competencies into government policy development and program design, and redesign. Governments must concern themselves with creative renewal, frequently by devolving power and authority to the most effective level of government where possible, or the politics of separation will continue into the next decade at the expense of our innovation, creativity and our environment.

Moving to changing definitions and values of what constitutes relatedness fundamentally challenges our existing ways of how we view nature and our relationships with it. One of our principal challenges, therefore, is to move from a single distorting lens view of what constitutes integrity and culture to multiple apertures and the flexibility to allow for co-evolving multiple perspectives. We must redesign human institutions to be in harmony with the functioning of natural systems, preserving the integrity of the self-organizing processes within ecosystems, human communities and individuals. We need to encourage credible inquiry

A reconciliation framework should embrace both "heart and mind" — the soft and hard approaches of multiple paradigms and perspectives, rather than a "new" or "alternative" approach that, in the end, only achieves power by marginalizing the "other" approach.

(Lister, Electronic Dialogue, April 22, 1997)

and discourse, often of the kind suppressed within organizational systems (Bella, 1994).

We live in a world with multiple realities and pluralities. We need an emphasis and the valuing of both commonalities and differences. Emergent relations and processes can only come from the synergy of complementary differences, not from preserving traditional separations. Valuing one over the other denies diversity and leads to separations that on the surface appear rational and natural, but in reality are based on the bankrupt politics of power and divisiveness. However, mere changes in worldviews or paradigms shifts are not likely to be sufficient. Political and social arrangements that implement these values will be essential for turning deeds into actualities (Ophuls 1977).

Table 9.1, Institutional characteristics that support sustainable development

(adapted from Rueggeburg and Griggs 1993)	(Dale 1998)
Integrated and Coordinated Integrative: each part of an institutional system interprets its mandate broadly to take into account all three dimensions of sustainability (social, economic and ecological).	**Reconciliation** Integrative: all decision-making for sustainable development fundamentally integrates ecological, social and economic imperatives within a guiding framework.
Comprehensive: each part of the institutional system recognizes all values associated with the resources it addresses and/or services it delivers. It employs the principle of 'full cost accounting' in assessing the outcomes and impacts of decisions.	Comprehensive: competing paradigms, and conflicting worldviews are explicitly recognized and made transparent as part of the decision-making process. Multiplicity of perspectives and contexts are venues for action.
Co-ordinated and Transactive: each part of the institutional system recognizes linkages with other parts of the system, seeks to harmonize its activities and those of others and promoted a co-ordinated approach to achieving overlapping activities.	Transcendent: Each part of the institutional system recognizes it is a part of a larger whole of furthering democracy through strengthening civil society.
Efficient and Effective	**Flexible and Responsive**
Efficient: institutional system seeks to reduce overlaps and redundancies in the mandates and activities of its component parts; two or more parts of the system do not duplicate efforts. This criterion recognizes, however, that some degree of overlap is necessary to support integration and to ensure the "robustness" of the system in being able to respond to unexpected events.	Flexible: unnecessary overlap and duplication are eliminated through integrated decision-making and the development and continual refinement of a guiding framework for operating across government.
Effective: each part of the institutional system has a sufficient mandate and the required level of staff and resources to run processes, make decisions, implement results, and monitor and review outcomes as necessary to achieve its objectives. The operation of the system produces meaningful results from the perspective of those operating in the system, as well as recipients of services provided by the system.	Effective: resources are efficiently and effectively deployed to respond to emerging issues, particularly at the domain level.
Long term and Adaptive	**Long term and Responsive**
Strategic and Anticipatory: system is perceptive, looking for present and future opportunities and challenges. It establishes priorities to take action based on an assessment of the scope of impacts, irreversibility of decisions and actions, and urgency; in addition, it has the capacity to address short-term crises, undertake long-term planning and also anticipate and respond to issues which occur at "in-between" speeds.	Strategic and Restorative: system responds equally to ecological, social and economic feedbacks, in particular, it has the ability to recognize and respond in a timely fashion to negative feedbacks from ecological systems, particularly with respect to losses of diversity at all scales.

Precautionary: institutional system recognizes that social, economic and ecological limits exist, though they may not be definable. It takes a cautious approach to solving problems and making decisions to ensure that outcomes are within those limits.	Contextual: systems of governance recognize and respond to the differing time, place and scale phenomena of both natural and human activity systems, recognizing there are absolute limits on human activities imposed by the biosphere. Accordingly, decision-making systems reconcile an ecological framework of spatial boundaries with socio-political boundaries, taking into account the finite limits on place and scale imposed by the biosphere. A cautious approach is to live well below those limits, rather than near or at the limits, in order to maximize resilience and security of all systems.
Reflexive and Adaptive: institutional system has the capacity to keep up with changing values and knowledge and to review and improve decision-making processes. It has the mandate and tools required for self-evaluation and self-modification. It shows leadership not only in questioning the way things are done, but also whether the "right" things are being done. This is not just a latent capability but an active role.	Responsive: decision-making processes are enlarged policy-making contexts, transdisciplinary fora that bring together a multiplicity of stakeholders with relevant experiences to bear on the issue, including natural and social scientists, public policy practitioners and the non-governmental community.
Open, Balanced and Fair	**Open and Inclusive**
Representative: each part of the system provides opportunities for all affected interests to be represented in processes, decisions and actions.	Equitable access: involvement in decision-making by the plurality of interests concerned is key. Diversity of representation in processes, decision-making and actions, plus employment of a multiplicity of approaches is emphasized.
Equitable: system ensures that the costs and benefits of decision-making processes, and their outcomes, are distributed fairly among those affected; appeal mechanisms are provided for those who feel that their interests have been overlooked or undetermined.	Embeddedness: identification with our connectedness, and also recognition of our being a small part of a larger grouping, provides a foundation for concerns for history, inter-generational and global equity, and awareness of the needs of "others" (Josselson 1996).
Participatory and collaborative: institutional system provides opportunities for individuals and groups representing different interests to cooperate in decision-making and take actions that affect their future while sharing responsibility for outcomes.	Networks of collaboration: institutional system recognizes the complexity, incomplete knowledge and uncertainty inherent in living systems, and that no one sector can solve the complex societal issues. Their role is to stimulate networks of collaboration around "domains of interest" leading to solutions and responsive actions.

Responsive and Accountable: each part of the system responds in a timely fashion to the constituency it serves and provides mechanisms by which individuals or groups can be held responsible for decisions and actions taken by that constituency, however, these mechanisms are not so rigid as to inhibit creativity.	Integrity: integrity of information is critical to the responsiveness of the system, particularly negative feedbacks from ecological systems. In order to be able to respond to negative feedback information, subsidiarity is fundamental.
Conflict-resilient: the system provides mechanisms to deal constructively with conflicts within and between its component parts, and with other institutional systems.	Open: Mutual learning occurs in open policy dialogues, which value discovering main areas of both agreement and disagreement.

A Framework for Governance

The principle of rough equality suggests instead that diffuse feedback processes in the natural world should be matched by diffuse decision processes in human societies.
(Dryzek 1990, p. 208)

In spite of a significant increase in the number and kinds of laws, policies and programs directed at managing natural systems, (over 120 international treaties and conventions, and over 250 such agreements at regional and local levels established since the 1970s (Holdgate 1996), there remains a substantial gap between the formal intent of such laws and their actual effect on natural systems. These implementation gaps can be partly accounted for by the inadequacy of organizational structures and administrative processes in the management of natural systems. Given the nature of sustainable development described in Chapter 7, it is clear that the present organizational capacity of the federal government, as outlined in Chapter 8, with its predominant vertical structure, calls for a redesigned institutional order (Paquet 1997). Some of the main organizational issues are fragmentation, jurisdictional gaps, polarization of interests, jurisdictional conflicts, piece-meal and uncoordinated polices, conflict of resource uses, and lack of coordination, trust, communication and collaboration (Lowry and Carpenter 1984). Another major barrier is the Anglo-American view that since we live in a market society, there is consequently no need for any philosophy of governance (Paquet 1997). Another is the declining trust in government: 67 percent of Canadians say they have little or no confidence in their political leaders (Environics 1995).

Public disenchantment with the political system may not abate if the new fora emerging in response to their demands are simply manifestations of earlier entrenched vested interests. In addition, if their procedures are flawed, then they will only serve to further increase public alienation and disrespect for elected officials. Both levels of government, that is, elected and non-elected officials, need to recognize the legitimacy of this pressure and begin to fundamentally address public concerns for greater participatory democracy.
(Dale 1995)

Because competition is valued more than collaboration in most industrial cultures, the more agencies responsible for the management of natural systems, the greater the risk of inter-departmental conflict; thus, the greater the need for interagency coordination and communication (Mayntz 1978). As well, significant gaps and time lags in the implementation of management efforts, and continual changes in environmental and social conditions, increase the turbulence of the fields in which these organizations exist (Emery and Trist 1972). There is, thus, a fundamental mismatch between the structures, processes and functioning of natural systems and those of governmental organizations. This limits their ability to both respond effectively to early warning signals from ecological systems concerning the cumulative human impacts on the environment, and to act in collaboration with these systems.

Another matter of concern is the effectiveness of the National Round Table with respect to changing government decision-making and influencing policy decisions. This raises the question about whether or not shared decision-making can exist within a Cabinet Committee decision-making framework. This subject merits serious consideration if shared decision-making is to be meaningfully realized. The question of the relationship between duly constituted multistakeholder bodies, especially when convened by governments, with constitutional decision-making processes should be addressed or else these bodies may ultimately lead to paralysis of the decision process by excessive participation, reverting back to reliance on "experts" and traditional back-door lobbying by the vested interests.

(Dale 1995)

In its 1997 report, the World Bank called for the reinvigoration of public institutions, maintaining that an effective state is the cornerstone of successful economies; without it, economic, social and personal development is severely limited. Good government is not a luxury, but a vital necessity for civil societies. A precondition for the rapid diffusion of sustainable development principles and practices is, therefore, the development of effective institutions. Thus, our institutions must be recognized as key barriers and humanly devised facilitators of human interaction. They structure incentives in human exchange, whether political, social, or economic, and shape the way societies evolve through time (North 1990). Institutions are in a position to provide the leadership for positive human actions, but if they are inflexible and isolated, they can readily become maladaptive and prevent positive change.

Policy failure has also been identified as a major barrier to the implementation of sustainable development, being responsible, for example, for much of the current environmental damage in the agricultural sector (FAO 1991; Hill 1998; International Development Research and Policy Task Force 1996; MacRae et al. 1990; Norgaard 1994). Paquet (1997) identifies as an additional barrier: rationalities, non-rational reasons and unconscious psychodynamic processes. Alternative rationalities are regarded as major threats as they threaten current power relationships; non-rational reasons are often invoked to prevent a full debate on dominant paradigms; and psychodynamic processes, such as anger, denial, and face-saving behaviours operate partly unconsciously when leaders are forced to consider alternative agendas. What is clearly needed are public debates about the limitations of the old paradigms, in order to create analytical and reflective space for the development of policy alternatives within government.

What ways, then, are appropriate for spanning the multiple and contending outside stakeholders that government must engage if, indeed, it is to participate in enlarged decision-making contexts? Such contexts are unlikely to be established unless a new social context emerges through the spread of trans-bureaucratic organizations and the creation of a common ground around the necessary changes (Emery and Trist 1972). Numerous case studies (New Brunswick forestry policy, Everglades, Chesapeake Bay and its watershed, Columbia River Basin, Great Lakes Basin Ecosystem and the Baltic) have underlined the importance of consensus building and collaboration in solving problems (Berkes et al. 1998; Westley 1995). We need to move from closed to open policy-making processes; from issues that are single sector and domestic to ones that are transdisciplinary and global; from government as controller and monitor to catalyst and leader; from citizen participation based on exclusive invitation and exclusion, to one based on rights, competency, and responsibilities of inclusion; from policy analysts as technical specialists to each of these being just individual members of transdisciplinary teams; from management that is primarily vertical to managers that can operate in both horizontal and vertical milieus; from homogenization to a diversity of values; and from a horizon that is short-term and reactive to one that is long-term, proactive, and multiple in time, place and scale perspectives.

> ***Our belief that we are independent agents deters us from recognizing how very much our beliefs and behaviour, our ways of evaluating persons and events, are shaped by our myths and our habits. Our prevailing beliefs about what is "naturally" worthy of aspiring to and doing—our myths—and reflexive dependence on what has worked well before—habit—are attractive ways to leave our minds uncluttered, our behaviour reliable, and our anxiety levels low. Institutions and organizations depend on just those attractions to appeal to stakeholders and membership. Thus learning, which mostly upsets beliefs and habits in individuals and organizations, is hardly likely to be embraced easily and enthusiastically, even though there is a growing, and sometimes powerful, recognition of the need for change.***
>
> (Michael 1995, pp. 469-470)

Gunderson et al. (1995) argue that being adaptive means, among other things, being able to respond to environmental feedbacks. Although I earlier cautioned against the dangers of adaptation, I would argue that even with any adaptation of humans to their environment, or what I term, responsibility to nature, that human activity systems must mimic, wherever feasible, ecological systems (Jordan et al. 1987; Mitsch and Jorgensen 1989; Perrings et al 1995; Soule and Pipper 1992). Our modern context no longer provides any space, ecological, social and economic, and perhaps, even psychologically, for continued quantitative growth. It is no longer a case where we have the room to manage our environment, if indeed it was ever possible, but rather we are in a situation in which we have to design systems of governance that allow us to collectively manage growing human impacts with the primary aim of reducing them. We are now beyond adaptation for, in many ways, adaptation means accepting the dominant socio-economic paradigms, and merely involves continually adapting our behaviour to the inevitable negative outcomes. Rather than adaptive management, albeit perhaps an important short-term transition strategy, I argue that our long-term solutions require "proactive responsible, co-evolutionary management". The end of the previous chapter includes a description of responsible, co-evolutionary institutional characteristics, based on the guiding framework of reconciliation of the three imperatives, developed through the electronic collaborative inquiry.

> ***When the sub-systems of society were less interdependent, policies could be more discrete and separate agencies could administer their own programs with minimum interference to each other. The greater degree of interdependence has changed this situation. Diffuse problems now arise affecting several sectors or indeed the whole of a society and these problems tend themselves to be interconnected. Examples would be poverty, obsolescence, urban decay, pollution, overpopulation, regional disparities, water and other natural resource management issues, and intergenerational conflict.***
>
> (Emery and Trist 1972, p. 89)

We now have to develop ways of organizing that work in synergy with ecosystem functions and processes, recognizing natural limits and maintaining rather than exploiting resilience and diversity. We need to encourage decision-making contexts that facilitate integration of multiple knowledges and experiences. The need for integration and synthesis is particularly evident in problem-oriented, man-centered, change-sensitive, future-oriented and holistic endeavours dealing with new knowledge of human nature, interdependence of human and social issues and problems, growing globalization of humankind and interdependence of all the basic knowledge systems of man (Hill 1979).

> ***Domains are based on what Vickers (1965) called "acts of appreciation." Appreciation is a complex perceptual and conceptual process which melds together judgments of reality and judgments of value. A new appreciation is made as a new meta-problem (Chevalier 1966), a problematique, or "mess" (Ackoff 1974) is recognized. As the appreciation becomes more widely shared, a domain begins to be identified.***
>
> ***Since problematiques, meta-problems, or messes—rather than discrete problems—are what societies currently have to face up to, the cultivation of domain-based, inter-organizational competence has become a necessary societal project.***
>
> ***The importance of the regulation by stakeholders can scarcely be over-emphasized, for there is considerable danger that the organizational fashioning, the institution building, the social architecture required at the domain level in complex modern societies will either take the wrong path or not be attempted at all.***
>
> (Trist 1983, pp. 270-271; 273)

By employing more open-ended policy processes that engage the users of resources and key decision-makers from civil society, feedback loops come closer to the locus of decision-making, with the result that officials can no longer ignore or deny the broad and longer term outcomes of their actions.

The framework for governance that I am proposing integrates some features of matrix management (Mintzberg 1989) through the prioritization of policy domains across government, shortened feedback loops through multistakeholder processes and the bridging of science and policy through enlarged, transdisciplinary policy-making and decision-making contexts, supported by expanded external networks of collaboration. Traditional bureaucratic models are clearly dysfunctional given the co-evolutionary nature of our contemporary environmental contexts; therefore, we need advances in institution-building at the level of inter-organizational domains (Trist 1983).

Governments can then become the nexus of both the generalized and specialized knowledgeable resources that can be applied to the joint creation of social policy and action.

> *Government is an organizational construct that is often stalled in bureaucratic or political gridlock. Governance on the other hand, implies a far broader social act that calls on a variety of agents and values to deal with the fierce demands of global interdependence.*
>
> (Young and Von Moltke 1993, p. 4)

Their most important role is transformed to being the most logical convenor of value-driven, collaborative catalyst (Westley and Vredenburg 1996) for action. Governments and their institutions would become the mediating factor that determines the collective relationships between social groups and the life-support ecosystems on which they depend (Berkes et al. 1998). Governments could assume this role because of their greater accountability through the electoral process, their role as an "honest" broker on behalf of both civil society, and their access to the required resources.

Such collaborations, however, must transcend dualism (Dillon 1988) and avoid the necessity to assert superiority of the opposite in order to prove the worth of the alternative. They must recognize that our concepts of biology and nature are already distorted by gender and power relations (Jiggins 1994); they do not merely reflect the given structure of reality itself. Any framework for governance, therefore, must tie policy development to illuminating deeply-rooted values and beliefs about how the world works. This is because, as argued in previous chapters, human activity can no longer be sustained on the basis of the present biases and imbalances. Respect for diversity, nurturance and a potential for oneness mediated by reciprocity should be regarded as integral to our human condition (Ibid 1994). Indeed, the strength of civil society in the 21st century can be expected to become increasingly dependent upon interconnected webs of relationships and reciprocal influences.

> *The ambiguity and imprecision surrounding jurisdictional authority would seem to have undermined the scope of federal environmental policy historically and contributed to a weak enforcement regime. However, the effects of federalism on policy outcomes are difficult to isolate from the impact of other factors among them the predominance in government and industry circles of a development/production-oriented technology, and the existence of closed policy networks in which industry and government officials have collaborated in the formulation of policies and environmental implications.*
>
> (Skopstad and Kopas 1992, p.49)

Sahl and Bernstein (1995) have created a framework (Figure 10.1) for developing policy in an uncertain world that takes into account fundamental values and beliefs about how the world works. Given that there are multiple concepts, frameworks, approaches and specific tools that are available as inputs for policy development, these authors stress the importance of explicitly organizing and choosing among divergent alternatives. There are a range of policy options, including containment, accommodation, adaptation, management, mitigation and suppression (Ibid 1995). In their model, making explicit our paradigms and world views, and examining their appropriateness, are consequently an important part of the recursive process that is necessary for the refinement of appropriate sustainable development policies. This then feedbacks into the consideration of policy approaches, strategies and tactics.

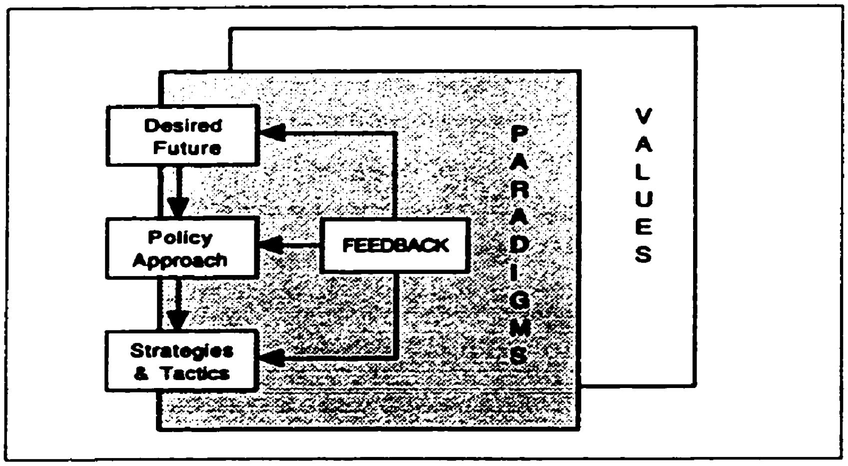


Figure 10.1 Policy development (Sahl and Bernstein 1995)

Based on Habermas' (1990) work on discourse ethics, which argues that the pluralism and complexity of modern life make it impossible to formulate universal, abstract, and strictly objective solutions to problems, and that public agreements can be arrived at and tested only through a public process, I have modified Figure 10.1 accordingly, to enlarged decision-making contexts.

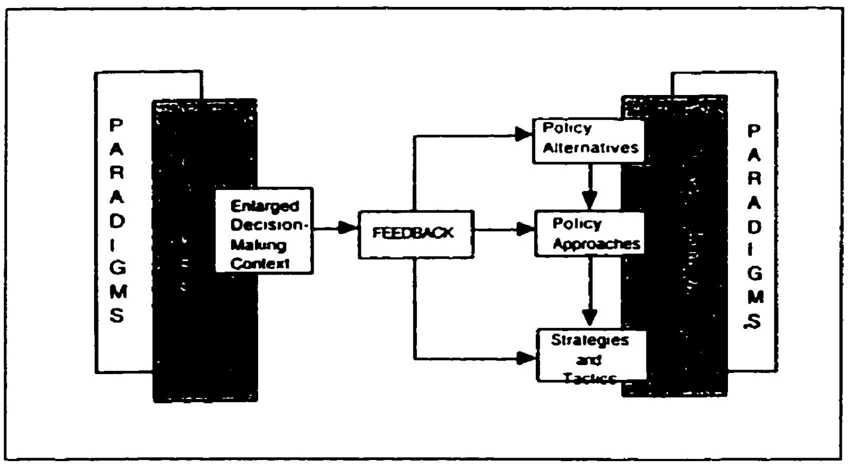


Figure 10.2 Responsible policy dialogue

Thus the policy development process is opened up to an enlarged decision-making context that is able to incorporate into the process the diversity of public values and paradigms of which governments need to be cognizant. Debates about competing perspectives, and of preferred states, which also invoke strong values discussions, are replaced by discussions about policy alternatives, against the current contexts. Values then emerge through the course of discussion about preferred policy alternatives rather than at the macro level of preferred states, out of which I maintain that deeply held values will still emerge. Most importantly, however, it opens up the process to feedback and evaluation from outside of government, rather than being a strictly internal phenomenon. By doing this, ideally the system will become equally sensitive to negative as well as positive feedback loops. The detection of feedback and evaluation of processes and outcomes should be conducted by those directly affected by the policies, by stakeholders closest to the problem (multiple scales), and by a plurality of stakeholders whose future choices may be affected.

My model also differs from that of Sahl and Bernstein in that it assumes that because paradigms exist at a deeper level of consciousness than values, paradigmatic thought influences our values. As Tomkins (1962, p. 13) observed, "the world we perceive is a dream we learn to have from a script we have not written . . . Instead of putting a mirror to nature we are . . . putting the mirror to a mirror".

In addition to opening up the policy process, there is an equally pressing need to build new domain-based linkages and competencies to deal with meta-problems such as sustainable development (Trist 1983). Sustainable development spreads horizontally across the conventional divisions of knowledge in the natural sciences, the life sciences, the social sciences and the humanities. It also spreads horizontally across departmental structural arrangements. It is assumed that the context is a turbulent and "hostile" environment (see Appendix S), which can be made less threatening and turbulent by explaining problem solving at the level of the domain.

The domain of sustainable development is fundamentally about values, it is a normative concept. Values are, therefore, central to sustainable development decision-making. When these values, however, are so absolute as to render any compromise by the stakeholders at the table to be immoral, then the parties cannot bargain in good faith. Effective dialogue is dependent upon how extreme and non-negotiable individuals hold their particular values. These values are also strongly influenced by paradigmatic thinking or worldviews that participants bring to the dialogue. Stakeholders have to accept that by entering into a multistakeholder process, they are by definition agreeing to search for mutually advantageous, although not always easily reconcilable solutions common to society as a whole, what Trist (1983) refers to as joint appreciation. They are also agreeing to developing a new negotiated order that transcends their own personal agendas, a mechanism that Grey (1989) sees emerging from the interaction of the stakeholders.

(Dale 1995)

Figure 10.2 also assumes greater uncertainty, more future orientation and greater interdependence, and this necessitates more comprehensiveness (Emery and Trist 1972). Moreover, it assumes that the constraints of bureaucratic structure and norms are more limiting than human cognitive processes, which can be stimulated to greater creativity by moving outside of the bureaucratic constraints of single organizations, and by considering issues at a new meta-level (Gregory and Keenery 1994). It also assumes, through the creation of networks of collaboration rather than referent organizations, that power differences can be minimized, and new hierarchies and other bureaucratic rigidities will not develop, thereby allowing for creative renewal.

Whereas Trist (1983) is arguing for the establishment of more permanent, less fluid and more central organizations, such as referent organizations, I argue for the building of more organic, responsive policy domains around emerging and emergent issues across government. These need to be supported, however, by networks of collaboration for policy development leading to an enlarged advisory context for political decision-making and, in some cases, depending upon the particular issue under consideration, and whether or not decision-making can be devolved, an enlarged decision-making context. In this way, client constituencies of the sectoral departments can be exposed and enlarged through these transdisciplinary fora to become more inclusive and national, rather than just federal. As well, with government serving as a supportive resource to these fora, they can become semi-permanent and more stable than most of the loose ad hoc coalitions that currently exist, thereby creating a counter-balance against the existing vested interests.

A network is a set of elements related to one another through multiple inter-connections. The metaphor of the net suggests a special kind of interconnectedness, one dependent on nodes in which several connecting strands meet. There is the suggestion both of each element connecting through one another rather than to each other through a center.
(Schon 1971, p. 190)

It is crucial, however, that the deliberations of these networks of collaboration are open and transparent, so that the political level becomes more accountable. So, for example, if the government chooses to ignore the policy advice given by these networks, it would be forced to make transparent the political trade-offs involved. For example, in the United States, once the scientific advisory panels have given their advice to the government, the panels can publish their findings and recommendations. In addition to making scientific advice available to the wider Canadian public, these transdisciplinary fora bring together the science and policy communities, with the academic and policy communities, rather than working in isolation from one another, in vertical solitudes (Zussman and Jabes 1989). They thus remove the opportunity for the policy development process diluting or, in some cases, ignoring the internal advice of its specialists.

In this non-hierarchical model, no one community is regarded as above or below the other. In the event that consensus is not achieved around selected issues, then that disagreement is forwarded to the political level for their subsequent decision and, at the

Domain appreciation is likely to be guided by the recognition of two principles:
(i) that the quality of life is affected by the quality of the social reality all system levels (not merely the individual, and in all dimensions of value (not merely the economic); and
(ii) that welfare and development have become inter-dependent in the transition to post-industrialism — welfare in its widest connotation of growth (change) that is progressive and order-producing rather than regressive and disorder-producing.
(Emery and Trist 1972, p. 97)

Network roles such as systems negotiation, underground manager, broker, and facilitator vary in character and yet make common demands on their practitioners, each of whom attempt to make of themselves a node connecting strands of a network which would otherwise exist as disconnected elements. The risks of the roles are many, since the broker may often be squeezed between the elements they are trying to connect. The need for personal credibility is high, since each role demands that the person be acceptable and believable to different organizations and persons, each of whom tends to hold different criteria for acceptance.

(Schon 1971, p. 200)

same time, it is made public. By bringing both the external scientific and other academic advisors to the same table with public policy practitioners and specialists, in networks of collaboration structured around identified priority areas of the current government, mutual learning and direct feedback processes are created openly and transparently. This is not to say that everything can be solved by consensus. Indeed, as mentioned above, the exposure of major areas of disagreement is equally important within these enlarged, open decision-making contexts. Churchman (1979) advocates seeking disagreements rather than agreements in order to identify problems, rather than to seek adaptive solutions as a normative way to handle persistent conflicts, provided there are competant decision-makers available to make the final decisions.

This kind of participation of civil servants in open policy dialogues works 'horizontally' across government and society, rather than simply 'bottom up' from citizens to government. In the Netherlands, and especially in Canada, horizontal participation is especially important at the provincial level, where sectoral provincial regulations and plans (e.g., within the environmental sector, but also for agriculture, housing, traffic and so on) have to be integrated into national strategies. Participation is not only an end, but also a means for policies to be effectively implemented. "Participation is necessary for [and the development and implementation of] effective policies", says almost all literature on participation (Roe 1998, p. 380). In the Third World, for instance, the truly successful environmental projects are invariably those founded on voluntary effort (Chambers 1988; Scoones and Thompson 1994).This opening up of the federal government policy development process may well lead to new alliances between the natural and social sciences, and between science and the state (Norgaard 1989).

Living, dynamic and complex systems can only be adequately understood through a multiplicity of tools, techniques, methodologies and perspectives. The policy development process can no longer be such an exclusive, closed process of internal advisory experts. Rather, it must be open to plural methodologies, broader communities with transdisciplinary knowledges, and shortened feedback loops that facilitate response to both negative and positive information, as well as to multistakeholder creativity and evaluation. Multiple insights, methods, worldviews and disciplinary perspectives would allow us to become more aware of the complexity of social and ecological systems, as well as of the difficulties of taking appropriate actions. The enlarged policy process model described above, however, has to be accompanied by complimentary structural changes within government that actively facilitate the enlarged policy process model. The current vertical silos within the federal government are depicted by the following model (Figure 10.3).

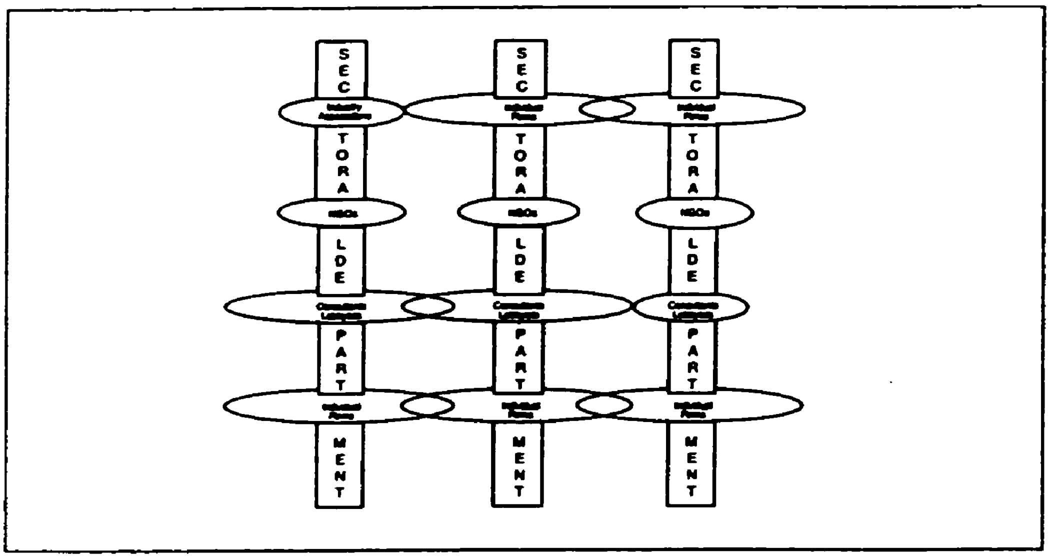


Figure 10.3 Vertical stovepipes and vested interests

In contrast, the framework for governance that I am proposing can be depicted by the following model (Figure 10.4).

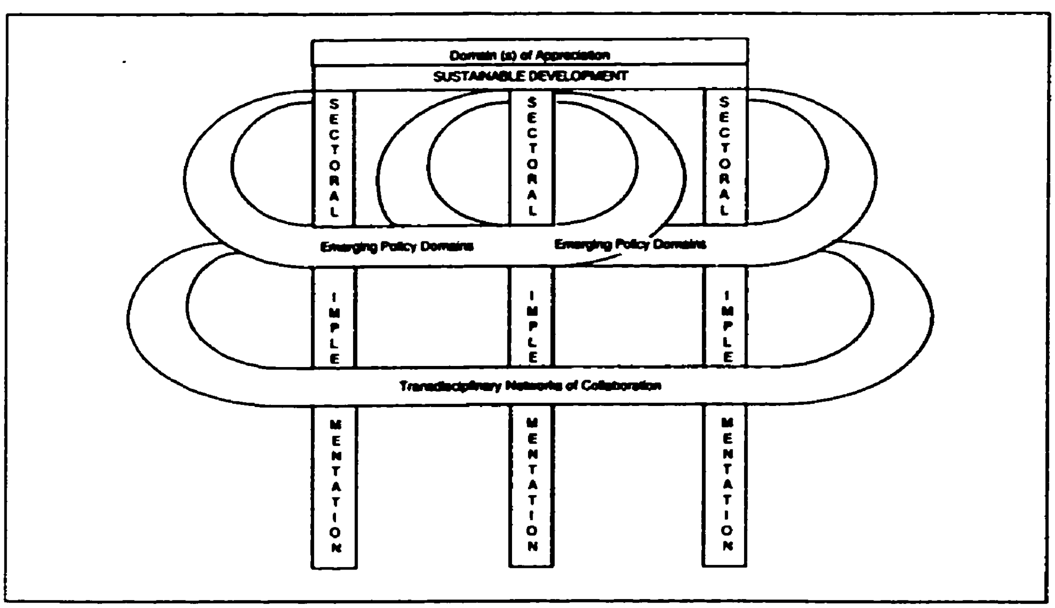


Figure 10.4 Transdisciplinary networks of collaboration: A transition phase

In this model, the main domain(s) of appreciation, and its associated policy themes, would be publicly identified by the incoming administration, through the Speech from the Throne. Domain(s) of appreciation operate at a meta-level of organization, cutting horizontally across existing structures. In this way, the domain level(s) is established in conformity to the democratic values of the political party in power. (Given my arguments in the preceding chapters, and the guiding principles for decision-making, I would suggest that in our current context there is only one umbrella domain of appreciation, sustainable development). In this model, domain collaboration becomes an inter-organizational means to achieve a desired end that no single department can achieve by acting unilaterally (Wood and Gray 1991). As well, some policy domains may cut across some, but not necessarily all, sectoral departments, and participation will have to be negotiated on a domain by domain basis, rather than the free-for all that now predictably degenerates into inter-departmental territorial battles. By shifting the focus from departments to domains, an inter-organizational policy space opens up, in which collaboration and greater effectiveness and efficiency is possible.

The current roles of the federal government of doing, controlling and monitoring are replaced by those of leadership and catalyzing networks of collaboration around clearly communicated policy domains. Collaboration, in this sense, is defined as "an interactive process having a shared transmutational purpose and characterized by explicit voluntary membership, joint decision-making, agreed-upon rules, and a temporary structure" (Roberts and Bradley, cited by Wood and Gray, 1991, p. 143). In this way, the power of the traditional vested interests is challenged by these new networks, by advice and information becoming more transparent, diverse and open to an enlarged post-normal scientific and other academic context outside of government. Expertise is broadened, no longer limited to internal and external corridors of power, to reflect the plurality of knowledges and expertise throughout the country and beyond. Putting in place a diversity of expertise, enlarged and expanded space is then created for policy alternatives and for dominant paradigms and meta-barriers to be exposed. As well, fundamental conflicts are also exposed, and periods of sustained reflexivity opened up around key strategic themes. Schutz (1967) defines reflexivity as the ability to periodically suspend our natural attitude and notice the matter-of-course, taken-for granted ways in which our communities of knowing are constructed and interpreted. This can open novel possibilities for changing them. For only sustained reflection can identify the hidden paradoxes, the dominant contextual paradigms, and facilitate innovative and creative solutions that allow emergent properties to emerge from the synergy created through these transdisciplinary networks of collaboration. The current national view of Ottawa policy-making as incestuous, insular and an isolated process that, most importantly, contributes to the weakening and loss of identification with government is thereby democratized and opened up for improvement. Through collaborative negotiations, stakeholders can be identified and collaborate to develop a common language; norms and values governing ongoing interaction can be established; authority, responsibility, and resources can be allocated (Westley and Vredenburg 1991); and exposure to wider values and paradigms held by diverse stakeholders would be facilitated. This kind of lateral-flexible organizational form relies on peer-to-peer relationships (as opposed to vertical hierarchies) in developing policy advice from multiple communities of knowing, based on the concept of a community of knowing as an open system (Boland and Tenkasi 1995).

These domains have to be loosely coupled, overlaying the vertical departments, thus allowing for the ongoing creative destruction and renewal, discussed in Chapters 4 and 8. Loose coupling suggests the idea of building blocks that can be grafted onto an organization or severed with relatively little disturbance to either the blocks or the organizations (Weick 1976). The domain and the departments would thus be responsive to one another, yet each would preserve its own identity and some level of physical separateness. In this way, policy deliberations and expanded public dialogue would be separated from implementation, with departments responsible for implementation of programs and regulations consistent with the overall policy agendas determined by the political level through the advisory mechanisms of policy domains. What is available for coupling and decoupling within an organization, however, is an eminently political question that allows politicians to have greater leverage on the system. Under conditions of loose coupling, it is anticipated that considerable effort would be devoted to examining constructions of social reality, examination of alternative paradigms and linguistic work, as well as exposing dominant myths and metaphors (Mitroff and Kilman 1975).

Bearing in mind the principle of rough equality of communicative capability, we should be wary of highly centralized decision mechanisms—national environmental bureaucracies, multinational mining or logging corporations, international resource management agencies—which could dominate, ignore, or suppress local ecological signals. The principle of rough equality suggests instead diffuse feedback processes in the natural world should be matched by diffuse decision processes in human societies.

(Dryzek 1990, p. 208)

Returning to the fisheries case study, described in Appendix Q, let us now integrate the various components of the models combining Figures 7.2; 8.3; 10.2 and 10.4 and the guiding framework developed in Chapter 9, and examine how enlarged decision-making and policy contexts would have made a difference. This case study illustrates a number of policy failures and structural impediments. First, there was very conflicting scientific advice concerning the size of the stocks, and the reasons for the decline. Second, there were vertical silos between the internal scientific advisors and the policy development process. Third, there were vertical solitudes and apparent differences between external fisheries scientists and department scientists. Fourth, the scientific advice was in some cases presented in a language not easily understood by non-scientists. Fifth, the Cabinet decision-making process was opaque in two ways: first, any advice that is given to Cabinet, both from its scientific and policy advisors, is regarded as confidential and not subject to access to information. Second, as the Cabinet decision-making process itself is not open, the trade-offs and issues involved in the decision-making are unavailable for more critical examination. Lastly, it would appear that regional disparities played a large role in these trade-offs, giving one Cabinet Minister disproportionate influence over both the delivery of information to Cabinet and its final deliberations.

The question of standing is also paramount to the politics of joint problem-solving, and criteria around "who is a stakeholder". Selection of stakeholders must be rigorously defined for each process and eminently defensible. There are accountability issues with respect to these collaborations. Because accountability is so diffused in the non-government community and industry is accountable only to private shareholders, governments have the greatest accountability because of the electoral process. Without the participation of Government as one of the stakeholders, the possibility remains that groups simply become a glorified, if somewhat more elevated, form of consultation for governments or entrenched interests to use to add weight to their own agendas.

A basic rule for any such process would be that if the participants cannot come to closure over who should be at the table, then the process should be immediately stopped. Similarly, the parties should define the sectors or areas to be represented at the beginning of the process, which once again becomes non-negotiable upon closure, simply because bargaining after the fact renders the entire process subject to lobbying by vested interests. Participants may attempt to increase their stakes at the table, by artificially creating sectors to increase the number of seats they have at the table. If the selection criteria for stakeholders are not defensible by the key parties to the process from the beginning, then the body is not duly constituted, rendering it illegitimate. Moreover, if these bodies, through their composition, do not reflect the "voices" not normally heard, then they will not respond to current public demand. Canadians are not demanding more of the same, but rather, greater representation and legitimacy in decision-making.

(Dale 1995)

Using my proposed models, the policy development process would be opened up to many more of the stakeholders in the Atlantic Canada cod fishery. Stakeholders are defined as agencies and citizens having a stake in the outcome of the decision, who are able to influence key constituencies affected by the outcomes of the deliberations (Dale 1995). This clarification is necessary, I believe, because essentially everyone can claim to have a "stake" in the environment, and since multistakeholder bodies are assumed to be convened in order to influence government decision-making and/or policy deliberations, then participants are at the table in order to bring various constituencies to bear on the issue(s) involved in the discussions. Another assumption is that because multistakeholder processes involve dialogue, some conflict will be inevitable. This necessitates expert facilitation and an awareness that consensus will not necessarily be reached in all cases; lack of consensus may be as informative as consensus.

In the case of fisheries policy development, key stakeholders would include the users of the resource, takers and managers of the resource, government senior policy practitioners from both federal and provincial levels, individual fishers, fish processing owners, fishing associations such as the Nova Scotia Groundfishermen, and the P.E.I Fishermen's Association; well-known academic fisheries specialists such as Ludwig, Hillbourne and Walters whose views differed strongly from those of the Federal Department, internal government scientific advisors, community activists and environmental non-government organizations.

Using the guiding framework developed in Chapter 9, it is highly unlikely that the same decisions could have been taken, especially if, for example, the principles of limits, precautionary principle, resilience, scale and a systems approach were part of the guidelines. Adopting a systems approach, for example, may have eliminated some of the polarized scientific advice about whether the size of the stock was being primarily affected by a change in ocean temperatures or over-fishing. Most likely stock size would have been shown to be the result of both effects dynamically interacting in novel and unknown ways. In addition, the effects of scale would have been highlighted through the participation of single hook and line fishers and owners of the factory freezer trawlers. This framework would certainly have prompted a discussion on values, as well as exposing the dominant paradigmatic thinking underlying the various positions. Perhaps one of the most important civil society questions would have been raised through this process, a question that we do not know whether or not was ever considered. That is, is it more sustainable to employ individual hook and line fishers or to employ large-scale factory freezer trawlers? Could a sustainable fisheries accommodate both?

Consensus has an important part to play in multistakeholder processes. If a duly constituted multistakeholder body reaches consensus, there is a stronger imperative for Governments to consider the decisions, especially if Government has been a participant. Of equal importance, however, is when a multistakeholder dialogue exposes areas where value conflicts are so intractable as to be unresolved, or the inability to make trade-offs using these processes, then the stakeholders have to recognize the legitimate right of Government to resort to their authoritative decision-mode. Consensus is not always possible, and indeed, not all conflicts can be resolved, nor should they be resolved through these means. Consensus may indeed prove to be elusive in the near-term, as will when existing information sources are inadequate to allow participants to meaningfully assess the ramifications of their decisions or policy advice, and indeed, move beyond win-lose scenarios, to totally new solutions. The availability of information and its ability to be integrative is crucial to this process. Consensus can be built only if there is agreement on a shared information base that facilitates a common understanding.

(Dale 1995)

Of course, the composition of expertise at the table is of primordial importance in exposing differences and allowing for consensus. The selection of experts who also have interdisciplinary expertise in addition to disciplinary expertise is critical for integrative modes of inquiry between the natural and social sciences, as discussed in the previous chapters. Exposing scientific differences may have led to more meaningful information being shared with the political decision-makers, either in terms of illuminating the differences or through an emerging consensus. Concentration on the size of the stock masked the underlying human over-exploitation, which would probably have been exposed through my proposed form of dialogue.

One of the main barriers facing sustainable development is the fundamental lack of ecological literacy within the public service, and even more so, within the political community, and the general public (Orr 1994). How information is presented and communicated to these groups is crucial in terms of influencing their decision-making. Moreover, by including stakeholders from the community, particularly activists and environmental non-government groups, then scientific advice from the forum can go through an initial filter of being able to directly communicate to non-scientific colleagues at the table.

One of the tragedies of the collapse of the Atlantic cod fishery is that the controversy was, in fact, being debated in academic fisheries journals, but these have very limited circulation. Most importantly, the fisheries debate would have reached the wider publics before the predictable collapse by making the debate transparent through transdisciplinary fora, perhaps thereby exerting different pressures on the political decision-making level, rather than leaving it solely in the hands of the traditional vested interests operating at that time.

> ***If participants cannot agree on a common information base, then the process must be stopped until this issue is reconciled, for power dynamics during the direction-setting phase are largely played out through efforts to control the process of the negotiations and the flow of information (Gray 1989). Recognizing that there is no such thing as perfect information, or value-free information, and that more information does not necessarily imply better information, these requirements must be identified at the beginning of the process, its nature and type, as well as the best means of securing the information. With this preliminary direction, experts can be instructed to begin compiling the common data base and alerting the process very early on about the gaps, in order to allow participants to decide how crucial these gaps are to their deliberations. Gaps are inevitable because of the existing inadequacies in sustainable development information, and therefore, multistakeholder bodies must collectively decide whether or not they can proceed on the basis of the best available information.***
> (Dale 1995)

In addition, it would have bridged the internal solitudes between policy development experts and their scientific advisors. In many departments, scientific advice is fed into the policy development process, and since this also is based on an internal advisory process, one never knows to what extent the advice is accepted or ignored, nor the trade-offs made at the bureaucratic level, even before it reaches the Cabinet decision-making level. A key feature of these fora is that once their advice is given to Cabinet, it may then be made public. Thus, greater accountability is placed on Cabinet in terms of the trade-offs they make, and whether or not they choose to ignore the expert advice when reaching their decisions. As well, the power of any one individual becomes limited as a result of this

> ***Multistakeholder bodies have the capacity to become a creative way to transform public institutions and facilitate shared decision-making. They can be a unique vehicle for clearly articulating stakeholder values and using them as the basis for creating an improved set of policy alternatives (Gregory and Keenery 1993). They will fail, however, if they serve only to legitimize existing hierarchical structures; if they become hostages to expertise, and they are constrained to dispute resolution issues. Their strength lies in building upon the stakeholders' current knowledge base and by bringing their different experiences, values and judgments together to identify in some cases, the trade-offs; in others, the policy solutions; in others, resolution of specific issues; and hopefully, in others, entirely new solutions that leap over existing paradigms.***
> (Dale 1995)

Even in settings where communication appears unproblematic and knowledge homogeneous, the nets of individual communities differ. It is through the dynamic interactions between such communities that new configurations of the knowledge net emerge by creating new meanings, new linguistic routines and new knowledge.

Their hermeneutic attitude means they avoid debate in favour of dialogue unless compelling reasons call for a dialectic communicative process. They realize that the debate is a win-lose polarizing strategy that rarely results in true synthesis or creative insights. Dialogue, in contrast, is mutually reinforcing, working together through languages. It is a realization that we can assume a perpective—taking orientation and benefit from opening ourselves to the horizon of another.

(Boland and Ramkrishrian 1995, pp. 352 and 366)

level of transparency and greater accountability.

Dialogue, at the same time, in the same place, and with a continuity of stakeholders, leads to deeper understanding and greater knowledge around the issues than the traditionally narrow expertise that normally exists on key sustainable development issues. In addition, the creation of an external transdisciplinary network of collaboration around sustainable fisheries would also have built a counter-balance to the vested interests influencing Cabinet at that time, notably the fish processing industry and their promotion of the use of factory freezer trawlers.

In fact, these networks of collaboration in the long run have the capacity to become networks of civic engagement, as they would mirror the way social and political networks are organized horizontally, rather than the present power based hierarchies. A more appropriate role for governments in the next century may well be to support processes that increase social capital, which will ultimately lead to a growth in strengthening both ecological and economic capital, given their long-term interdependence. In reality, the social capital embodied in norms and networks of civic engagement seems to be a precondition for economic development, as well as for effective government (Cox 1995; Putman 1993). As well, it may be hypothesized that the establishment of more common ground will reduce disassociation and alienation. Current experience and expectation (outside the usual narrow range of social encounters) of lack of common ground inhibits needed exploration and increases isolation (Emery and Trist 1972, p. 189). Wise policy can encourage social capital formation, and social capital itself enhances the effectiveness of government action. I propose going a step farther, with governments actively leading the creation of networks of collaboration that stimulate greater civic engagement; for I believe that the effectiveness of government and, ultimately, the vibrancy of democratic systems of governance, are dependent upon on social capital.

How does social capital undergird good government and economic progress? First, networks of civic engagement foster sturdy norms of generalized reciprocity. Trust lubricates social life. Networks of civic engagement also facilitate coordination and communication and amplify information. When economic and political dealing is embedded in dense networks of social interaction, incentives for opportunism and malfeasance are reduced. Dense social ties facilitate gossip and other valuable ways of cultivating reputation—an essential foundation for trust in a complex society. And finally, they embody past success at collaboration, which can serve as a cultural template for future collaboration.

(Putman 1996, pp. 2-3)

11

Conclusions

The greatness of a nation and its moral progress can be judged by the way its animals are treated.
(Mahatma Gandhi)

The previous chapters have described how ecological, social and economic capital is declining, albeit at differing time, place and space scales. Nevertheless there appears to be an increasing convergence towards human and natural system collapse worldwide, the more that these three imperatives for human societies diverge. This collapse will be inevitable given the increasing co-evolutionary nature of human and natural systems. The greater the divergence between these three imperatives, it may well be the more rapid the decline. For example, since writing the previous part of this dissertation, the global economic system has entered a unique breakdown of what was previously considered the exciting "new frontier" of the Asia-Pacific Rim, involving newly industrializing nations such as Korea, Indonesia, and China, and some industrialized nations such as Japan and Russia. World stock markets and some currencies are now fluctuating wildly, on a scale previously not encountered by modern society. This oscillation, however, is not surprising given the current scale of the economic system through globalization and hence increasing economic interdependencies, coupled with some of the delinkages mentioned in Chapter 6.

> ***What metaphors? Ones that map a fluid, amorphous, problematic, information-rich world of multiple myths such as: reciprocity, resilience, circularity, emergence, birthing, dying, development, balance, mirroring, ebb and flow, cultivation, seeding, harvesting, potential, fittingness, both/and, multiple causality, and multiple consequences.***
>
> ***Less abstractly, there are metaphoric potentials to be derived from the domain of biological growth and development, things take time, nurturing, maturing.***
>
> ***There are metaphoric potentials from the realm of ecology with its concepts of interdependence—you can't do just one thing—diversity, resilience, competition and collaboration, carrying capacity, vulnerability, cyclicity, continuity, and, again, time for development.***
>
> ***And embracing all these, are the learning-related metaphors: discovery, exploration, adventure, questing, knowledge, insight, new experience, risk, vulnerability, error, success.***
>
> (Michael 1993, pp. 87-88)

The implementation of sustainable development is therefore one of the most important human imperatives for the 21st century, requiring strong leadership by local, regional and national governments. The adoption of a framework that applies across governments is critical to their ability to provide consistent and effective leadership to other sectors of Canadian society, in order to diffuse its concepts and practices in the next decade, before irreversible crisis thresholds are reached. A guiding framework based on the reconciliation of the three imperatives, ecological, social and economic, is critical if governments are to be able to assume a leadership role in the implementation of sustainable development. And governments are considered to be the most logical convenors of the plurality of stakeholders who need to be at the table when making sustainable development decisions. As discussed throughout this dissertation, the complexity of the issues demands fundamentally deep structural changes in the way we do business, the way we conduct our day-to-day lives and the way we make decisions. The only way that such changes will occur, however, is through exposing the dominant paradigms and values and restraints that work together to create the existing powerful movement for resistance at so many levels.

There are many alternative ideas circulating within society; post-modernism, feminism, post-normal science, deep ecology, participatory action research, bioregionalism, ecosystem approaches (Edwards and Regier 1988; Francis 1994) and systems theory, that have yet to be discussed by mainstream agendas. These emergent approaches and paradigms provide important new information about the ways in which our human activity systems work, and they equally inform us about our understanding of the natural world and our relationships with it, with one another, and with other species. Just as the current dominant socio-economic paradigms, metaphors and myths act as powerful barriers against change, there is danger that these emergent schools of thought can become just as linear and reductionist as normal science, if they are not seen as transcendent. That is, they have the potential to become reductionist if they are regarded as the only world view, and if people believe their reality derives from the natural world. Rather, they are simply a new way of thinking about the real world and human relationships with that world, and are essentially paradigm shifts in the way we deal with information and its circulation in the modern world. The potential of these new ways of relating with the world will not be realized, however, if we stay at a shallow level of applied thought to systems, if they do not challenge our fundamental beliefs and values and cause us to change our behaviour towards our world, our relationships with each other, and most importantly, with other species.

Resistance to these emergent paradigms happens for a wide variety of reasons at all levels: individual psychodynamics, societal socialization, disciplinary educational systems, and institutional gridlock. I have chosen to focus on the latter, for the many stovepipes (Figure 10.3) within our institutions and deep solitudes between sectors are major restraining forces against the implementation of sustainable development. These two forces work together to produce an increasing decision-making gridlock, where quite often the lowest common denominator prevails because of the extensive trade-offs that are made in the hierarchical, dualistic, rational-expert decision-making model that currently operates in the federal bureaucracy.

Another powerful barrier is the fundamental lack of ecological literacy among the bureaucracy, and most particularly at the political level. Moreover, the latter work in an environmental context of urgency, denial of alternatives and unreasonable deadlines so that sustained reflexivity and opportunities for new learning are virtually non-existent. This makes the political decision-making level even more dependent upon the quality of information they receive from their bureaucratic advisors, as well as the many external sources hoping to exert influence on their decision-making. Bureaucratic stovepipes, coupled with lobbying from vested interests, has created a positive feedback loop for incremental change at best, and change that only marginally, if ever, disrupts the status quo (or extrapolations of it).

Given the co-evolutionary relationship between human and natural systems, I have assumed that many of the same structures and processes necessary for sustaining natural systems can act as important analogues for human activity systems. Consequently, in order to begin writing about ecological imperatives, because of my ignorance, I have had to learn (as most Canadians would) about ecological systems and how they functioned, albeit at a level of generality. Although I originally intended to look at the characteristics of ecological systems that could link both human and natural systems, time constraints and the scope of this dissertation allowed for only some preliminary linkages to be made. This is an important critical area for future research, and how to communicate key ecological information to both the bureaucratic and political decision-making levels is critical.

In evaluating local carrying capacity, we must also consider larger-scale impacts on other ecosystem capacities for both sources and sinks, as well as temporal effects (Dale et al. 1995). There are many social systems that have developed cultural patterns that deviate significantly from the way that ecological systems function. They have been able to persist, however, only because they have compensated for these deviations by transferring costs to the future, to other locations or to the buffer/sink capacity of the surrounding ecosphere. This can only work, however, in a world in which the impact of the cultural/social subsystem is smaller than the rate of ecosystem carrying capacity regeneration, or where the uncertain capacity of the future is forced to absorb added burdens from the past. My co-researchers and I have assumed that human activity systems are most like the third circle in Figure 7.1, meaning that we are already approaching critical threshold limits of the biosphere and that we have already borrowed extensively from the capital of future generations. Furthermore, there was unanimous agreement that there are limits to both the biosphere functioning and to human carrying capacity. The capacity of human systems to apparently transcend time, place and scale through globalization, and the unlimited use of resources and technologies, although seeming to allow human systems to supersede ecosystem principles in the short-term, results in the discounting of ecological services that are critical for all life.

Hopefully, human activity systems will be able to respond to the sustainable develop-

Diversity means variety. Diversity comes in many different forms, each of which is a relationship that fits precisely into every other relationship in the Universe and is constantly changing.
(Maser 1992, p. 11)

ment imperative before too many more future options have been foreclosed, particularly with respect to biological and cultural diversity. There are complex societal decisions to be taken concerning the relative scale and size of human activity systems in relation to natural systems; particularly since, in general, human carrying capacity can be increased only at the expense of other species (Dale et al. 1995; Dale and Hill 1996). The degree of biodiversity in the natural world will be highly dependent upon our ability to nurture diversity within our human activity systems. When diversity within human systems is valued, and even actively planned for, then it is more likely that biodiversity will be maintained, and greater equity may well be an emergent property. How to promote and maintain diversity (of space — mental, physical, cultural and spiritual; of place — built and non-built; of organization — self and process, structure and function; and of scale — at the micro, meso and macro levels) are crucial questions. In addition, we have to ask the fundamental question how much human carrying capacity are we prepared to support at the expense of other species? And what repercussions will this have for our own species over the long-term? How much is enough (Durning 1992)?

Human carrying capacity, coupled with the notion of "limits" of the carrying capacity of the planet, argues for a co-evolutionary management system of human impacts on natural systems, based on respecting the critical (of which we are only beginning to be aware) linkages between their respective structures and processes, both positively and negatively. At a minimum, such a co-evolutionary framework must include the reconciliation of economic, ecological and social imperatives within the context of sustainable development. It also must emphasize the importance of closed loop/feedback systems especially in systems that become increasingly open. And it implies some notion of "limits" that applies equally to both physical and human spheres. Perhaps rather than just being concerned with carrying capacity, we should perhaps also be concerned with "caring capacity", a relational understanding rather than an understanding derived only through reason and intellect.

This raises complex social and ethical questions such as what are the characteristics of the co-evolutionary relationships between natural and human systems? What values are pre-requisites for this co-evolution? What conditions facilitate its development? Are there ways to respond more proactively to negative feedback loops in our co-evolutionary relationships? How do human systems determine their appropriate carrying capacity - locally, nationally and globally? Is carrying capacity plastic, as some experts claim, as a result of human ingenuity and potential new technologies, or is it fixed? Other meta-logue questions involve the nature and scale of the limits to the biosphere. Rather than adaptive management, which I see as a reactive response, we should proactively be bringing the best knowledges, experiences and expertise to bear on these questions, asking the deeper questions such as what it means to be human? What do we really need as human beings? What kinds of civil societies do we really want to create? What ways are there to manage our growing impacts on the biosphere, given our current projected population rates? Are there ways to introduce more congruence between the needs of human activity systems and the regeneration and maintenance of key ecological services?

These questions will not be asked, never mind addressed, unless governments change the nature of their relationship with and to the polity, through enlarged policy development processes and enlarged decision-making contexts through new transdisciplinary and pluralistic networks of collaboration. Sustainable development issues are, by their very nature, expansive and unconstrainable within traditional boundaries, they push at the frontiers of our current knowledge and experience, and continually test society's values. The importance of regarding the rich diversity of knowledge (and not just scientific knowledge) as a public good is highlighted by these processes, which involve complex organizational, informational, power and conflict issues. But deeper down, they are based on psychological processes that underlie our ability to deal with complex issues, the resolution or non-resolution of which have ramifications, not just in the present, but for future generations as well. The means necessary to achieve the ends in many of these issues is simply not clear in our present context.

The model of transdisciplinary networks of collaboration that I have proposed has the capacity, I believe, to become a creative way to transform our public institutions and to facilitate more effective shared decision-making. Such collaborative networks can be a unique vehicle for clearly articulating stakeholder values and using them as the basis for creating an improved set of policy alternatives (Gregory and Keenery 1993). They will fail, however, if they serve only to legitimize existing hierarchical structures; also if they become hostages to expertise, and they are constrained to dispute resolution techniques. Their strength lies in building upon the stakeholders' current knowledge base, by enabling them to bring their different experiences, values and judgments together to identify in some cases, the areas of disagreements and trade-offs; in others, the agreed policy solutions; in others, the resolution of specific issues; and hopefully, in others, the creation of entirely new approaches that leap over existing paradigms. And by making these fora semi-permanent, a new "politics" of sustainable development may emerge.

Ultimately, however, even these transdisciplinary networks of collaboration will fail unless stakeholders can put aside their disciplinary perspectives, their dominant perspectives and current operational contexts. This means in the long run, that in order to fundamentally achieve a reconciliation of the ecological, social and economic imperatives, the personal imperative has to be realized as an integral part of public life, for the personal is political. For in the long-term, the health of civil societies everywhere depends upon the reconciliation of the ecological, social and personal imperatives.

We know enough to act now (Dale and Hill 1995) and yet it is not enough that we simply put good structural changes in place in organizations and institutions; we must proactively involve Canadian civil society. It is clear, however, that virtually without exception, the more civic the context, the better the government (Putman 1993). And strong civic societies may be more dependent upon the rationality of human processes through greater levels of communicative and discursive dialogues than rationality of thought. Change, however, does not simply begin with the individual and spread to institutions in a linear way, but rather, meaningful change results from complex feedbacks and iterations between individuals and institutions (Dale et al., May 1997).

Although this dissertation has been framed in terms of the ecological, social and economic imperatives, in the long run, it is the personal imperative, rather than just the economic one, that most demands our attention (Gruen 1986; Hill 1988). The personal imperative involves personal reconciliation on many levels, individual, professional and relational. I thought it would be naive, however, to deny the dominance of the current socio-economic paradigm, and to recognize that what is needed is a transition strategy (Westley, personal communication) before moving to a framework based on this more fundamental integration.

It may be deterministic to predict what ultimately the redesigned governance will be, when sustainable development is constantly evolving. Similarly, Figure 10.4 represents a transition phase. In the long run, a totally new structure within government would be expected to emerge that transcends the current vertical and sectoral departments. We may, in the future, be looking at a population of collaborations within a problem domain, some grass-roots, some vision led and some government mandated, and a consequent dismantling of our current adversarial federal/provincial system. Given the complexity of the particular problem-domain being discussed, it may well be that government-mandated collaborations are the first step to identifying common solutions, followed by vision-led and grassroots initiatives for implementation and subsequent follow-up. In other contexts, it may well be that a government-mandated collaboration may be the last in a cascade of deliberations. The current departmental form of government organization may well become completely deconstructed and reconfigured in new ways as a result of these networks of collab-

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Don't forget that effective movements for change are built by ordinary people who perceive themselves in "do-or-die" situations. Sustainable development may be one of the paths to survival—certainly the concepts are a crucial part of what we are all working towards—but to make it really come alive as an active force in the world we need to marry the academic frameworks to a plan of action, and the actions need to include every one of us.

(Geuer, Electronic Dialogue, January 17, 1998)

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oration.

Another crucial question will be the meaning of the personal imperative for civil society, and how it can be realized individually and collectively, both locally and globally. Perhaps the root source of dualisms is the apparent separation of the emotional from the professional spheres, and the separation of our autonomous self from our adapted self (Gruen 1986; Hill 1998). In our adapted states, we cannot recognize alternative responses other than through further adaptation, to an increasingly unsustainable world. And emphasis on continual adaptation denies any responsibility on our part to change the underlying unsustainable forces in our current decision-making systems. Just as the frog slowly boils to death, through slow increases in temperature, so too, we slowly adapt to the positive feedback loops between human and natural systems. Just as we unwisely introduce unsustainable feedback loops, equally, we can actively design for negative feedback loops, that will demand a much higher awareness of the structures, processes and functioning of ecological systems and the co-evolutionary nature of human-nature systems. How to communicate this domain appreciation to key decision-makers, where ecological understanding is at best minimal, is a key question. As well, the incorporation of different perspectives of 'relationality', love and compassion, particularly in professional milieus, would appear to be a necessary pre-condition. Greater human progress may follow from the integration of the intellect and the heart, leading to expanded definition of valuing life to include all living beings, so that a nine-month old golden retriever puppy does not die in front of twenty people, because property rights take primacy in human activity systems based on dominance and power, and degrees of sentiency between living beings.

12

Reflections

There is a land of the living and a land of the dead and the bridge is love — the only survival, the only meaning. For it is the death of love that evokes the love of death.

In the first chapter, I wrote about the loss of one of my most loved animal companions, Odessa Mamut, when I began to write this dissertation. This was my first experience, as an adult, with losing prematurely someone I loved, and his death was particularly traumatic because of his suffering. I know many people did not understand the nature and depth of my grieving for "just an animal," and I realized how ironic it was that my values about other beings, in fact, deepened and made the process far more painful.

Bereavement is one of the most humbling of experiences, something over which I have learned there is no control. It has a rhythm and pathway that is different for every individual. If I tried to control the emotions associated with my pain, they would simply manifest themselves in numerous other ways: through physical illness, and eventually if persistently blocked, through emotional breakdowns, and the destruction of relationships. For example, 90 percent of marriages break up over the loss of a child (Sanders 1992).The very things that made me a good manager — the ability to control and predict, to lead when others were stressed — made me poorly prepared for accepting the free-flowing process of grief. Even while writing about and accepting the chaos and randomness of ecological systems in this dissertation, for example, I still believed that most parts of my life could be "controlled" and "managed". There was an orderliness to my life, and I believed being had a logical continuity. The only people close to me who had died had all been in their eighties. Grief changed all that. It is horrifying how quickly my entire life changed in an instant, making me keenly aware of how good my former life had been, now that it was irrevocably gone.

We went through the entire emotional sequence—grief, loneliness, reluntant responsibility—when we worked on the Club of Rome project twenty years ago. Many other people, through many other kinds of formative events, have gone through a similar sequence. It can be survived. It can even open up new horizons and suggest exciting futures. Those futures will never come to be, however, until the world as a whole turns to face them. The idea of limits, sustainability, sufficiency, equity, and efficiency are not barriers, not obstacles, not threats. They are guides to a new world. Sustainability, not better weapons or strugglles for power or material accumulation, is the ultimate challenge to the energy and creativity of the human race.

(Meadows et al. 1992, p. xvii)

Since then, I have lost two other animal companions, and thought that I had faced the worst of my troubles. Many told me that there was a purpose to all this, something I strongly rejected, as why would I deserve more purpose in my life than others, and this kind of statement seemed to speak of fire and brimstone, of punishment. I did not believe there was any reason why I should be particularly singled out for more purpose than others I felt more deserving. Unfortunately, the worst of times was yet to come.

On May 10, 1998, my beloved only child, Danny James Frazer, died. He was one of the most gentle, kindest and decent of men I have known, and I am very privileged to be his mother. He had such a wonderful integrity, to which I can now add a remarkable courage in trying to maintain that integrity. Some people when they are on Earth occupy only the space of a tree, but when they leave they leave the space of a forest. My beloved Danny was such a person. We are now trying to learn how to live at the edge of a forest. Just as your values determine the depth of your grief, the quality of the person you lose determines the depth of your loss. Paradoxically, I sometimes wish my son had not been so special, so gentle and kind.

To lose a child is, I believe, one of life's greatest tragedies, because it is so unnatural, and to lose an only child is like entering an abyss. In addition to the profound loss of the person, I feel I have lost my future, the grandchildren that will never be, of continuity, and parts of my identity. A terrible, singular void opens up. It is quite simply a primordial loss. I have been able to finish this dissertation only because I know it is what Danny would have expected, and in so doing, I honour him in life and death.

I now know more about the meaning of life through dying than living; and, paradoxically, I now no longer have those special beings with me to share that wisdom. I don't regret the meals I didn't cook, the house not being clean enough, but I do regret the times I wasn't there for hugs and for going for walks. For is not life simply about relationships and love and compassion? The issue is not control, but rather dynamic connectedness (Janstch 1980). And the meaning of purpose has emerged. Terrible events do not happen for a purpose, the purpose comes from how you take that event and how you live with it. For me, the purpose of Mamut's death was my learning how to hold a dead body for the first time, how to make death preparations and how to say goodbye. Without this prior learning, I would never have had the ability to say the "goodbyes" to my beloved son that I did on the morning of May 10th, nor would I be here today writing these conclusions.

In the last three months, I have learned so much, some very good things and some very negative things, for death holds a mirror up to everyone's soul, if only for a brief moment. For me, it feels as if it will be forever and ever. I have found that most people are afraid of being in the space I now occupy. We live in a culture in which there is a massive denial of death and our own mortality. Most do not know what to say, and many say nothing. Many have tried to deny me the space to talk about my loved one, and this becomes a double loss, their death, and then their entire existence. Many people have rushed to fill the abyss, even offering their children as surrogates. But just as Daly (1989) claims for economic systems, there are no substitutes for the person you have lost, the missing future cannot be replaced, it is all so irreplaceable. Rushing to fill the abyss is another form of denial; and failing to face the reality of a terrible loss, has a great price. Just as many rush to fill the void in the paradox between sustainable and development, and by doing so, merely tinker at the edges and maintain the status quo.

So people are at a loss at what to do, how to help, how to comfort. My sister remarked that all the wrong people are reading the books on grief, that people who are not grieving should be reading them, for advice on what to do. Perhaps the same thing is true for sustainable development, the wrong people are reading the information, we are writing for and reaching the already converted. If we valued becoming, rather than always focusing on being (Williamson and Pearse 1980), or, better still, on both, knowing in the moment what to do would not be so difficult.

Part of the grieving process is mourning the part of you that became lost with the person you lost. I have entered a process of fundamental deconstruction, for my former life is gone forever. This deconstruction, however, will not take place unless there are "safe places" in which to express my grief, that allows the process to unfold and a new self to emerge. The process is not linear or short-term, and often awakens other losses, and often involves interrelationships, as well as being linked to the relationship and depth of attachment with the deceased. It appears that only by staying in the wasteland of grief, that reconstruction can occur. Unfortunately, North American society allows very little space for living in the wasteland.

Because of the loss of my son, I am raw, it is as if every pore in my body has been ripped open, I have very little capacity to absorb "normal" daily events. My lens has been changed forever, and only I can determine its new shape if I can accept the risks of the free-fall of the abyss. I now live so keenly in the present, for the moment the past and the future have dropped away. Small things and details assume greater importance, the ability to "manage" life's day-to-day trivia is reframed in the moment. In spite of this "rawness", one is allowed only 4 days bereavement leave in most organizations. For me, this reveals the massive denial of death and the ignorance and denial of grief, that is part of our culture. It is a reflection of a deeply rooted structural psychopathology in support of the rational, expert model. It assumes that if you take a little time, then your normal professional self will take over. How does one accommodate the loss of a loved one, a mother, a

We must, indeed, recognize 3 types of potential limits: the "outer limits", essentially of a material character, such as are considered in the Meadows' report; the "inner limits", which are those of the social system, and the "innermost limits", which reside within the human individual.

(Postel 1987, p. 9)

father, or a child in just 4 days?

There are deep gender differences as well. I have been allowed much more "emotional space" than Danny's step-father but, overall, we have both been expected to get over it in about two months. There has been only one person, an artist, who had the sensitivity not to ask me how I was. There is no way to answer that question, for I can no longer say, fine, thank you, as I used to do even when I felt unwell. And anyway, most people do not want to hear the truth. No-one, unless they have experienced loss of this magnitude, has any idea of the depth of despair, nor are we encouraged to communicate that despair, except nominally in the beginning. Unless someone has experienced loss, they do not know the cost of simply existing every day, no-one talks about the vomiting, the shock, the terrible separation anxiety, or the deep hopelessness. In spite of all our education, we know so very little about the meaning of life and death, and its essential processes, and we fear it.

People's reactions to fear differ widely. Some respond with infinite compassion, others are quick to dismiss, to blame, to judge. These latter are mechanisms for distancing ourselves from pain. If one accepts that psychic pain is as painful, and may even be more painful than physical illness, then what right do we have to judge those who chose to end their pain? Just as with many environmental problems, because we cannot directly see psychic pain, we tend to base our decisions on incomplete knowledge, inaccurate information, and fear of the unknown.

Death shines a mirror in everyone's face. It can help us face our own mortality and the meaning of life and death, if only for a moment. For a moment, one's values become so clear and in immediate focus. Many people have told me that Danny's death has helped them to re-examine their priorities. In some ways I am glad that other people's lives appear to be enriched by his death, but it is little comfort for me, for I will never hear him say 'Mum' again. For those of us who have deeply loved and lost, it is such a solitary journey. People rush to try and make me feel better, to fill the void, but there is nothing to be done, but to face it, there is no running away, just as, there will be no turning back as we reach the limits of the biosphere.

Presence is a moment when all ranges are present, or when we are experiencing the wholeness of the spectrum rather than the characteristics of just one of the ranges. It is a moment—a condition—when the totality of our existence synergizes and blends with our world, expanding the ranges of the reality we inhabit as well. And it does so through attunement, through weaving itself gracefully into our world.

(Spangler 1996, p. 77)

The language around death also manifests our denial of one of life's essential processes. A particularly painful comment is "you'll get over it". One quickly learns there is no getting over it. Rather, one learns how to live with it, by accepting and developing a new pair of spectacles. What would my framework be like now, if I had been taught from a young age, different realities about death, its inevitability, its naturalness, and particularly that the death of the parts is necessary for the life of the whole, that perhaps there is an extended space-time-continuum (Jantsch 1980). More importantly, what if I had learned as a young child that I only have control over myself, how different would my relationships have been? How different would our relationship with the world be if ecological literacy was valued as deeply as written literacy?

As previously discussed, human activity systems cling stubbornly to continuous cycles of exploitation and conservation, allowing only a little release when external pressures become too great, and seldom, if ever, entering into deep renewal. If we saw death as a natural release, as creative destruction, and grief as an integral process of that destruction, it opens up new spaces for renewal. By denying death and grief, we deny renewal (Westley, personal communication). Similarly, if we provided analytical space for policy alternatives, differing paradigms and a plurality of values, greater possibilities would be opened up for institutional renewal corresponding to current realities, rather than, remaining alienated and contributing to greater fragmentation and divisiveness in society.

One of the main barriers to meaningful change in our current ways of being is that we are living in massive denial of the ecological information that surrounds us. I believe it involves complex issues of unresolved grief, for what we do to the Earth, we do to our ourselves. If we accept that there are limits to the biosphere, then it also means there are limits to ourselves, for we are indeed mortal. We live in massive denial of this, the health profession regards death as a mortal enemy, and something to be avoided or postponed at all costs. Perhaps if death were not closeted away and seen as an integral part of life, then it may allow for more creative destruction and renewal at all levels of the individual, psychic, emotional, mental, spiritual and collectively as well.

Evolutionary leaps in self-organization, new forms of relationality and knowledges seem to occur particularly during periods of extreme physical or emotional pain, grief, trauma and death. The paradox is that acute clarity (Baeker May 1997), vision and vitality appear to occur during moments around life and death, joy and pain (Lister, E-mail correspondence, May 16, 1997). Sustained reflection (Baeker May 1997) around these moments of extreme clarity at the core of the paradox (Lister May 1997) and the heart of the void (Dale May 1997) may allow for meaningful change to emerge. Change, however, involves giving up something, and therefore, there is a process of mourning involved in accepting change (Day March 17, 1997). It is not easy to live in a void, but denying the void is to deny personal development and possibly, long-term survival, both individually and collectively.

When my son Danny was a little boy, and again especially over the last two years when he was ill, when coming home at night, I remember that I used to wish upon the brightest star: "Starlight, starbright, may I have the wish I wish tonight. May my lad be safe

> ***The one thing that's true of all exceptional patients is that they are people who have become authentic. They do not reach the point of death only to find that they've never really lived. Sometimes they only "really live" for a few moments before they die. But they have lived and they are ready to go, as their choice. They know who they are, where they've been and why. This makes it easier for them to let go, and for their loved ones to let them go when they are tired and sore.***
>
> (Siegel 1990, p. 246)

tonight". When I said my final goodbyes, I kissed his eyes, his nose, and his mouth, as I did when he was a little boy, and I asked him, if he could, to shine more brightly once in a while from the sky. I have, on occasion, seen a single star shining with great clarity and brilliance, just as Danny lived his life on this Earth.

May he be running on the other side of the Rainbow Bridge with our faithful companion, Mutts. See you at the bridge, my beloved Danny.

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Appendix A

These appendices follow in the order in which they are referred to in the body of the text.

History of the Concept of Sustainable Development

> A conserver society is a society which promotes economy of design, favors re-use, recycling and reduction of resource use, questions the ever-growing per capita demand for consumer goods, and recognizes that a diversity of solutions in many systems, such as energy and transportation, might in effect increase their overall economy, stability and resiliency.
>
> (Science Council of Canada Report, 1977)

Although the concept of sustainable development has been around for a number of years (Brown 1981), it was popularized in 1987 when the Brundtland Commission published its report, *Our Common Future*. By widely promoting this concept, the Commission wisely sidestepped the polarized growth debate initiated by the Club of Rome's seminal document, *Limits to Growth* (Meadows et al. 1972). Since the introduction of sustainable development into common parlance, numerous variations have emerged, such as sustainability, sustainable growth, sustainable economic growth, and sustainable environmental or ecological development. All of these variations, however, implicitly push us back into the old debate of no growth, limits to growth versus unlimited growth. Indeed, part of the strength of sustainable development as a concept lies in its constructive ambiguity, and in our attempts to generate a more meaningful definition. Although disagreement exists among different communities about the usefulness of the concept of sustainable development, it is recognized internationally and it does avoid most of the traditional left-right polarization and discourse about growth versus no-growth, by bringing together the terms sustainable and development. Human societies everywhere will place a different emphasis on the former and the latter, according to their ecological, social and economic conditions. Despite its ambiguity, it has succeeded in uniting widely divergent theoretical and ideological perspectives into a single conceptual framework (Estes 1993). More fundamentally, it has brought a wide diversity of industrialists, environmentalists, public policy practitioners and politicians to round tables, in their attempts to deal with and actualize.

In 1980, the World Conservation Strategy, IUCN, UNEP, WWF, and others offered these useful statements relating to sustainable development.

> Development as the modification of the biosphere and the application of human, financial and living and non-living resources to satisfy human needs and improve the quality of human life. For development to be sustainable it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long term as well as the short term advantages and disadvantages of alternative actions.
>
> Conservation as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet

the needs and aspiration of future generations. Thus, conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment.

Conservation, like development, is for people. While development aims to achieve human goals largely through use of the biosphere, conservation aims to achieve them by ensuring that such use can continue. Conservation's concern for maintenance and sustainability is a rational response to the nature of living resources (renewability and destructability) and also an ethical imperative, expressed in the belief that 'we have not inherited the earth from our parents, we have borrowed it from our children'.

The integration of conservation and development is particularly important, because unless patterns of development that also conserve living resources are widely adopted, it will become impossible to meet the needs of today without foreclosing the achievement of tomorrow's.

In 1986, a statement to the World Commission on Environment and Development on behalf of Canadian environment, development and peace organizations (authored by Ralph Torrie) defined sustainable development as development that is capable of:

> meeting peoples' needs, as defined by them, in such a way that the potential for other people and future generations to meet their needs is not diminished.
>
> Sustainable development's implications are decentralized development that ensures people participate in decisions that affect them, appropriate changes in lifestyles and values, strengthened institutions to protect natural resources and the environment, improved efficiency of resource use, reduced arms expenditures, and changes in aid, trade and investment practices.

Subsequently, the currently popular definition of sustainable development from the Brundtland Commission states that , "Sustainable development is development that meets the needs of the present without comprising the ability of future generations to meet their own needs (WCED 1987, p. 43). With respect to the operational objectives of sustainable development, Our Common Future (1987, p.49) states that the strategic imperatives that flow from the concept are:

1. reviving growth;
2. changing the quality of growth
3. meeting essential needs for jobs, food, energy, water, and sanitation;
4. ensuring a sustainable level of population;
5. conserving and enhancing the resource base;
6. reorienting technology and managing risk; and
7. merging environment and economics in decision-making.

Barbier (1987) defined social sustainability as "the ability to maintain desired social values, traditions, institutions, cultures, or other social characteristics." Repetto (1986, p.17) expressed the idea of sustainable development as a tool for consensus.

> Sustainable development has three bases . . . scientific realities, consensus on ethical principles, and considerations of long-term self-interest. There is a broad consensus that pursuing policies that imperil the welfare of future generations . . . is unfair. Most would agree that . . . consign[ing] a large share of the world's population to deprivation and poverty is also unfair. Pragmatic self-interest reinforces that belief. Poverty . . . underlies the deterioration of resources and the population growth in much of the world and affects everyone.

In 1988, the National Task Force on the Environment and Economy, a body established in Canada to examine the findings of the Brundtland Commission, generally defined sustainable economic development as:

> development which ensures that the utilization of resources and the environment today does not damage prospects for their use by future generations.
>
> At the core of the concept of sustainable development is the requirement that current practices should not diminish the possibility of maintaining or improving the living standards in the future. This means that our economic systems should be managed to maintain or improve our resource base so that the generations that follow will be able to live equally well or better. Sustainable economic development does not require the preservation of the current stock of natural resources or any particular mix of human, physical and natural assets. Nor does it place artificial limits on economic growth, provided that such growth is both economically and environmentally sustainable. Sustainable economic development implies that resources and the environment must be managed for the long term, taking into account their possible value in the future as well as their value now.
>
> Sustainable development calls for a different approach. It would minimize environmental impact and future clean-up costs by advanced and integrated planning. In a phrase, the remedial reactive approach would be replaced by "anticipate and prevent" as the dominant concept underlying environment-economy integration.
>
> The goal of sustainable economic development cannot be attained without significant change in the way our economic initiatives are planned and supervised. This makes it a challenging goal, even more so in the Canadian context because it will require different approaches in various economic sectors and political jurisdictions across the nation, although the same underlying principles should apply to every jurisdiction.

In 1989, Bill Rees offered the following definition and five characteristics:

> Sustainable development is positive socioeconomic change that does not undermine the ecological and social systems upon which communities and society are dependent. Its successful implementation requires integrated policy, planning, and social learning processes; its political viability depends on the full support of the people it affects through their governments, their social institutions, and their private activities. Sustainable development:
>
> 1. is oriented to achieving explicit ecological, social, and economic objectives;
> 2. may impose ecological limits on material consumption, while fostering qualitative development at the community and individual levels;
> 3. requires government intervention, but also the leadership and cooperation of the private sector;
> 4. demands policy integration and coordination at all spatial scales and among relevant political jurisdictions, and
> 5. depends on educational, planning, and political processes that are informed, open, and fair.

The IUCN (1991) noted that sustainability refers to a process or state that can be maintained indefinitely. Pronk and Haq (1992) argued that sustainable development refers to the need for natural resources to be used in ways that do not create ecological debts by overexploiting the carrying and productive capacity of the Earth. Costanza (1991) further argued that a minimum necessary condition for sustainability is the maintenance of the total natural capital stock at or above the current level.

Meadows et al. (1992) defined a sustainable society as one that has in place informational, social and institutional mechanisms to keep in check the positive feedback loops that cause exponential population and capital growth. That means that birth rates roughly equal death rates, and investment rates roughly equal deprecication rates, unless and until technical changes and social decisions justify a considered and controlled change in the levels of population or capital. In order to be socially sustainable the combination of population, capital and technology in the society would have to be configured so that the material living standard is adequate and secure for everyone. In order to be physically sustainable the society's material and energy throughputs would have to meet economist Herman Daly's (1989) three conditions:

- its rates of use of renewable resources do not exceed their rates of regeneration;
- its rates of use of nonrenewable resources do not exceed the rate at which sustainable renewable sustitutes are developed; and
- its rates of pollution emission do not exceed the assimilative capacity of the environment.

Thus, the concept sustainable development has been constantly evolving from the earlier definition of the Conserver Society, becoming deeper in both scope and time, although all of the foregoing definitions are decidedly anthropogenic. There is growing consensus that the term sustainable development implies integration of the environment and the economy, with much less agreement about the inclusion of social issues.

The term, sustainable development, has provoked much criticism from a wide variety of scholars. Lele (1991) pointed out that the mainstream formulation suffers from an incomplete perception of the problems of poverty and environmental degradation, and confusion about the role of economic growth and about the concepts of sustainability and participation. O'Riordan (1988) noted that current visions of sustainable development are messy and politically treacherous. Others (Redclift 1988; Norgaard 1988) have argued that part of the definitional confusion surrounding the concept is not really about its meaning, but rather about what values should take precedence.

Appendix B

Basic Beliefs (Metaphysics) Concerning Inquiry Paradigms (Guba and Lincoln 1994, p. 109)

I see my study as integrating elements of critical theory and constructivist research paradigms.

Item	Postivism	Postpositivism	Critical Theory et al.	Constructivism
Ontology (What is the form and nature of reality?)	naive realism- "real" reality but apprehendable	critical realism- "real" reality but only imperfectly and probabilistically apprehendable	historical realism- virtual reality shaped by social, political, cultural, economic, ethnic, and gender values; crystallized over time	relativism-local and specific constructed realities
Epistemology (What is the nature of the relationship between the knower or would-be knower and what can be known?)	dualist/objectivist; findings are true	modified dualist/ objectivist; critical tradition/community; findings probably true	transactional/ subjectivist; value-mediated findings	transactional/ subjectivist; created findings
Methodology (How can the inquirer (would-be knower) go about finding out whatever he or she believes can be known?)	experimental/ manipulative; verification of hypotheses; chiefly quantitative	modified experimental/manipulative; critical multiplism; falsification of hypotheses; may include qualitative methods	dialogic/dialectical	hermeneutical/ dialectical

Appendix C

A Relationology of Mindscapes

(Dale and Regier 1995)

Magoroh Maruyama, an epistemologist from Japan, has described a "relationalogy of mindscapes" (Caley and Sawada 1994). This may be perceived to be a post-normal version, in the sense of Funtowicz and Ravetz (1991), of a "typology of mindsets". An "ecology of landscapes" may have some epistemological congruence with Maruyama's approach in that such an ecology is more about relationships than about types, and more about contextual rather than universal reality.

Maruyama emphasizes that his approach is not:

- a classification scheme,
- a search for a universal "one truth,"
- a product of theory, but rather learning from practice,
- relevant to testing of hypotheses like "A causes B", or
- an imaginary construct.

It is an approach to help a seeker with a mindset contained within a particular mindscape to perceive other possibilities. A small excerpt, based on Maruyama's work, is included in the following table to illustrate how individual psychodynamics can influence one's overall philosophies.

Mindscape Type	Overall Philosophy
H (Hierarchical: Utilist)	Parts of a system are subordinated to the whole, to an important degree. Universal principles apply to all. The system consists of structures, superstructures and infrastructures. The tip of the hierarchy is powerful.
I (Individualistic: Exploitist)	A system is merely an aggregate of individual subsystems that alone are real. Power is exerted autoarchically or anarchically.
S (Closed Holarchic: Preservationist)	A system consists of heterogeneous subsystems that interact reciprocally to mutual advantage, when in a healthy state. Interactions maintain a harmonious pattern of heterogeneity or go in cycles. Interactions in part are holarchic within a system that is largely closed to external or extraneous influences.
G (Open Holarchies: Integritist)	Heterogeneous subsystems interact for mutual benefit within an open healthy system. Reciprocal and holarchic interactions generate new diversity, new patterns, new harmony and new relationships for mutual benefit.

Within the above table the SOHO notion -- Self-Organizing, Holarchic, Open systems as sketched by Koestler (1978) and more recently interpreted by Regier (1995) -- has been melded with Maruyama's wording. I have also generalized his perspective as it relates human society to a broader perspective of an ecosystem with both cultural and natural polarities. I do not know whether Maruyama would concur.

Thus, exploitists may usually operate within an I mindscape, utilists within H, preservationists within S and integrists within G.

Maruyama points out that Western science and technology -- presumably including "environmental management" - has heretofore exhibited a kind of hybrid of H and I mindscapes. I may note that until relatively recently, Western interests in nature could be largely subsumed under the utilist and exploitist approaches, which I have linked to the H and I mindscapes above.

Though Maruyama apparently does not emphasize it, I suspect that many women in Western culture may be more comfortable than Western men are with the S and G mindscapes, and Western men may be more comfortable with the H and I mindscapes. This may help to explain why women are frequently more effective guides on issues related to biodiversity and ecosystem integrity than are men (Merchant 1995; Ruddick 1989; Shiva 1989).

It may also be the case that S and G mindscapes may be more widely represented among First Nations peoples of North America than among Western peoples. Thus, "traditional knowledge" may be predominantly relevant to S and G mindscapes and implicitly predisposed to preservationist and integrist interests, which are now strengthening within Western cultures.

Appendix D

Perceived Differences Between Quantitative and Qualitative Methodology (Sarantakos, S. 1993)

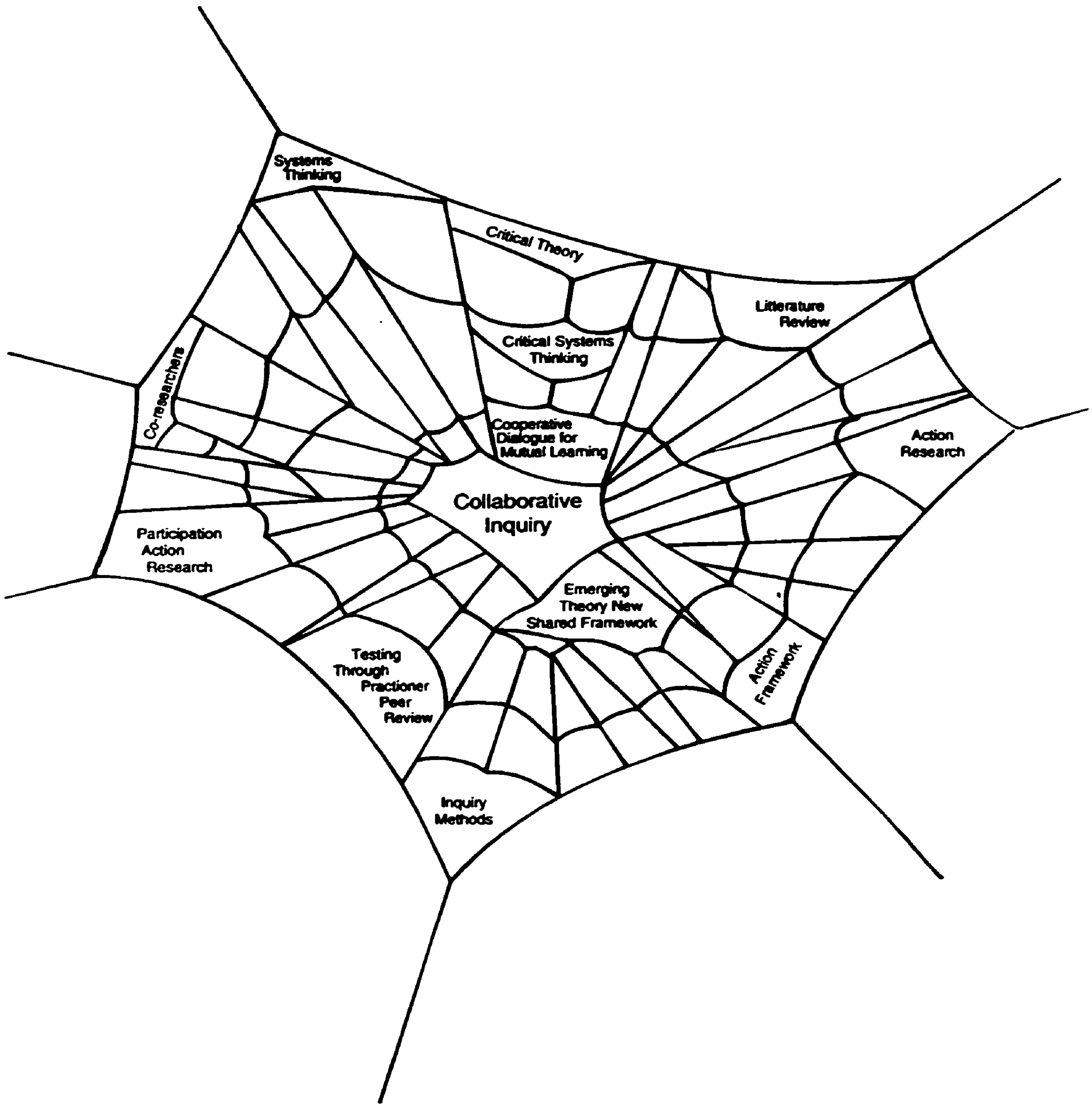
My research methodology was qualitative and conformed to the following criteria.

Feature	Quantitative Methodology	Qualitative Methodology
Nature of reality	Objective; simple; single; tangible sense impressions	Subjective; problematic; holistic; a social construct
Causes and effects	Nomological thinking; cause-effect linkages	Non-deterministic; mutual shaping; no cause-effect linkages
The role of values	Value neutral; value-free inquiry	Normative, value-bound inquiry
Natural and social sciences	Deductive model of natural sciences; nomothetic; deductive; based on strict rules	Natural and social sciences are different; inductive; ideographic; no strict rules; interpretations
Methods	Quantitative; mathematical; extensive use of statistics	Qualitative, with less emphasis on statistics; verbal and qualitative analysis
Researcher's role	Rather passive; is the 'knower'; is separate from subject--the known; dualistic	Active; 'knower' and 'known' are interactive and inseparable
Generalizations	Inductive generalizations; nomothetic statements universal truths	Analytical or conceptual generalizations; time-and-context specific

Appendix E

Collaborative Inquiry Model
(adapted from Elden and Lewin 1991)

My research methodology build upon a synthesis of a number of research methods, illustrated by the following web.



Appendix F

List of Strategic Questions Used to Develop the Research Proposal and Lead the Electronic Collaborative Inquiry

The following list of strategic questions was developed using the technique of strategic questioning developed by Fran Peavy (1986 and 1994), and discussed in Chapter 2. By using open-ended questions, this technique attempts to stimulate respondents to begin questioning their underlying assumptions and dominant thought patterns. It is another method for getting at "first principles" on the part of both the researcher and the co-participants.

1. What values, structures and processes would help move us from our present dominant socioeconomic paradigm to the suggested integrist paradigm?

2. Are there limits to the carrying capacity of the biosphere?
What is the nature of these limits?
Are they fixed (Rees 1992) or plastic, varying with what societies value (Regier 1995)?

In a research workshop at UBC, Henry Regier used a model of a simple heat pump to illustrate some of the concepts associated with carrying capacity as that concept might relate to assimilative capacity of ecosystems for harmful wastes. The heat pump was used to transfer waste heat from an external source into a closed vessel with particular physical properties (size, shape, volume, contents, properties of the vessel walls, temperature, pressure, etc.). By analogue the closed vessel was the ecosystem of interest, absorbing the waste heat (a proxy for wastes of various kinds) resulting from human activity.

Clearly the response to increased provision of heat to the closed vessel will vary depending on a whole set of conditions related to the physical properties listed above. The dissipative capabilities of the vessel (or natural system) appear to exist as a series of steps of different phases with respect to different features of the vessel. Some of these steps (e.g., with respect to current structure) may be fully reversible. Eventually, as heat is added, a non-reversible collapse of certain properties of the vessel occurs.

This simple model (which is of course much less complex than real ecosystems) already suggests that the concept of carrying capacity can be defined in many different ways, e.g. by limits of sustainability of particular uses of the ecosystem, by undesirable consequences of particular loadings into a system, by limits to the sustainability of certain properties of the ecosystem, etc. This in turn suggests that the definition of carrying capacity depends critically on what we as a society want. Any definitions, therefore, are inherently normative. Determining carrying capacity cannot be a simple matter of applying one definition, or determining one absolute or finite measure, but rather, must involve a complex series of interactions between the natural and cultural worlds. There is no one comprehensive picture of the totality of the overall system: moreover, natural systems, which are open, self-organizing, non-linear, and evolutionary, may not collapse initially as a result of human-induced loadings, but may flip to a completely different level or type of organization. There may well be multiple thresholds of multiple kinds.

3. Are there limits to economic growth, given a finite carrying capacity? If there are limits, what ramifications does this have for development versus growth?

> TO GROW means to increase in size by the assimilation or accretion of materials. TO DEVELOP means to expand or realize the potentialities of; to bring to a fuller, greater, or better state. When something grows it gets quantitatively bigger; when it develops it gets qualitatively better or at least different. Our planet develops over time without growing.
> (Meadows et al. 1992, p. xiv)

4. How would one encourage the economic system, assuming a finite and non-growing earth, to adopt or adapt to a similar pattern of development?

5. How can the concept of development replace growth as necessary for sustainable employment, social mobility, and technical advance? Is there a link, or new narrative for social change that can be made between development and progress?

6. What values facilitate co-evolution of natural and human systems, and what keeps the opposite in place?

7. What new metaphors, myths and narratives for social change could we use to encourage the emergence of more integrist (Figure 3.3) and life supporting paradigms, and what existing ones have to be changed?

What are the main barriers blocking such an emergence, and what are ways to weaken or remove them?

8. What role can governments play to reduce and eliminate the psychological, institutional and structural reasons for growth?

9. What is the impact of finite limits on human carrying capacity?

Is it possible to absolutely determine these limits, given the differences in competing paradigms, both economically and ecologically, as referenced in question 2?

For example, Daly (1991) views the crux of the issue as the positioning of the economy as an isolated system, or an open subsystem of a finite system. If the former, then there is no environment to constrain its continual growth. But, if we see the economic system as a subsystem of a larger, but finite and non-growing system, then obviously its growth is limited. The economy may continue to develop qualitatively, but it cannot continue to grow quantitatively; beyond some point it must approximate a steady state in its physical dimensions. Most mainstream economist and government policy analysts share the former view.

10. In your opinion, where are human systems in terms of their appropriation of the biosphere depicted in Figure 4.1, and on what do you base your opinion?

11. Is there any way to model these scenarios in a way that would be meaningful to politicians and senior-level bureaucrats?

12. What structures and processes from natural systems should be incorporated into human systems, and why (Figure 9.1)?

13. What ecosystem principles should be incorporated into human systems, and why?

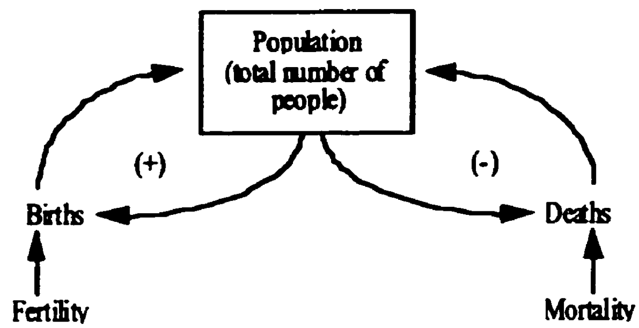
Examples of some ecosystem principles are integrity, resilience, dynamic equilibrium, evolutionary pathways, and self-organizing open and holarctic systems.

14. How can a sense of ecological time be reconciled with the short-term time frame of political decision-making?

15. How can you integrate time, place and scale phenomena of ecosystems into human decision-making?

16. Is there a way to redesign government information systems so that feedback loops from natural systems are systematically incorporated into decision-making, delays and lags reduced or eliminated, and policy changes are dynamically responsive?

For example:



On the left is a positive loop that accounts for the exponential growth. The larger the population, the more babies will be born each year. The more babies, the larger the population. After a delay while these babies grow up and become parents, even more babies can be born, swelling the population further.

On the right is a negative feedback loop that governs population growth. Whereas positive loops generate runaway growth, negative feedback loops tend to regulate growth, to hold a system within some acceptable range, to return it to a stable state.

(Meadows et al. 1992, p. 113)

17. How can human bounded systems, such as federal/provincial jurisdictions, become more flexible so that they compliment unbounded ecosystems?

18. What would the world be like if human beings co-opted 80% of net primary production (NPP)? Or 100%?

19. Are there existing transition strategies that would help in changing governmental values for sustainable development?

20. What government leadership initiatives would encourage industries to bring their flows of energy and materials below their source limits, and their wastes below the assimilation capacity of the natural environment?

21. Are there industries that should be made obsolete in a sustainable society? For example, the most intractable hazardous wastes are human-synthesized chemicals, and yet, every day, 3 to 5 new chemicals enter the marketplace.

22. How does one phase out and discourage unsustainable industries in a democratic capitalistic society? Which need to reduce, expand, or become established?

23. In what ways are population, affluence and technology interconnected to each other?

24. What institutional arrangements are necessary to identify positive feedback loops and to effectively respond to them?
What changes are needed in the way governments receive and process information?

> Note: In systems terms changing structure means changing the information links in a system: the content and timeliness of the data that actors in the system have to work with, and the goals, incentives, costs and feedbacks that motivate or constrain behaviour. The same combination of people, institutions and physical structures can behave completely differently, if its actors can see a good reason for doing so and if they have the freedom to change. In time, a system with a new information structure can socially and physically transform itself.
>
> (Meadows et al. 1992, p. 191)

25. Describe your vision of a sustainable world? How do we get from here to there? (A sustainable world can never come into being if it cannot be envisioned.)

26. What role do multistakeholder processes have to play in sustainable development?
What are their strengths and weaknesses, and how can we address the latter?

27. What collaborative networks are necessary to diffuse sustainable development concepts and practices throughout Canadian society?
Is there a role for Federal Government leadership?

28. How do we make explicit the dominant paradigms that are internal and external to governments as well as their influence on decision-making?
How do we test these paradigms and learn when they are no longer relevant to current societies?

29. How can government policy-making become more open and transparent and dynamically responsive to current and emerging realities?

Appendix G

List of Ordered Questions Used in the Electronic Collaborative Inquiry

The list of strategic questions in the preceding appendix was narrowed down and used in an ordered fashion to lend some structure and ground our cyberspace in some reality. As well, they facilitated the co-researchers to focus on developing a guiding framework.

1. What new metaphors, myths and narratives for social change could we use to encourage the emergence of more integrist (Figure 3.3) and life supporting paradigms, and what existing ones have to be changed?
   What are the main barriers blocking such an emergence, and what are ways to weaken or remove them?

2 What role can governments play to reduce and eliminate the psychological, institutional and structural reasons for growth?

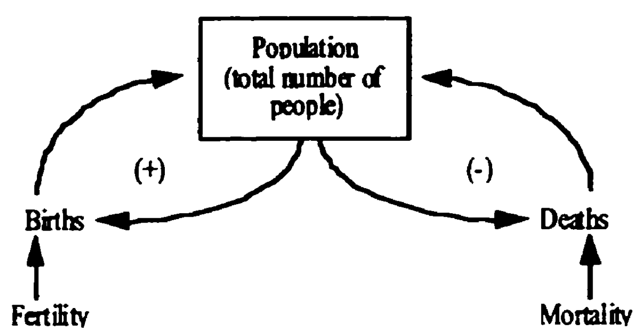
3. What structures and processes from natural systems should be incorporated into human systems, and why (Figure 9.1)?

4. What ecosystem principles should be incorporated into human systems, and why?

Examples of some ecosystem principles are integrity, resilience, dynamic equilibrium, evolutionary pathways, self-organizing open and holarctic systems.

5. Is there a way to redesign government information systems so that feedback loops from natural systems are systematically incorporated into decision-making, delays and lags reduced or eliminated, and policy changes are dynamically responsive?

For example:



On the left is a positive loop that accounts for the exponential growth. The larger the population, the more babies will be born each year. The more babies, the larger the population. After a delay while these babies grow up and become parents, even more babies can be born, swelling the population further.

On the right is a negative feedback loop that governs population growth. Whereas positive loops generate runaway growth, negative feedback loops tend to regulate growth, to hold a system within some acceptable range, to return it to a stable state.

(Meadows et al. 1992, p. 113)

6. How can human bounded systems, such as federal/provincial jurisdictions, become more flexible so that they compliment unbounded ecosystems?

7. What institutional arrangements are necessary to identify positive feedback loops and to effectively respond to them?

What changes are needed in the way governments receive and process information?

Note: In systems terms changing structure means changing the information links in a system: the content and timeliness of the data that actors in the system have to work with, and the goals, incentives, costs and feedbacks that motivate or constrain behaviour. The same combination of people, institutions and physical structures can behave completely differently, if its actors can see a good reason for doing so and if they have the freedom to change. In time, a system with a new information structure can socially and physically transform itself.

(Meadows et al. 1992, p. 191)

8. What role do multistakeholder processes have to play in sustainable development?

What are their strengths and weaknesses, and how can we address the latter?

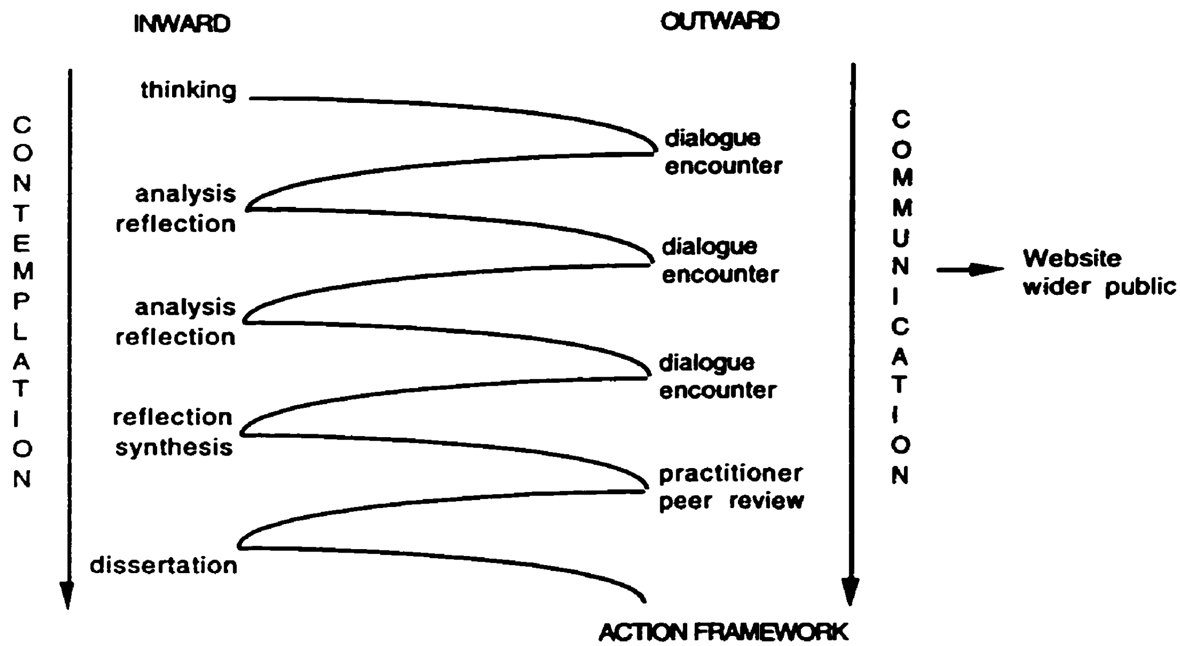
9. What collaborative networks are necessary to diffuse sustainable development concepts and practices throughout Canadian society?

Is there a role for Federal Government leadership?

Appendix H

Cycles of Reflection and Communication

The following diagram illustrates the cycles that I deliberately introduced in my leadership of the electronic dialogue, resulting in continuous cycles of reflection, discussion, analysis, reflection and dialogue and so forth. Hopefully, it also allowed for a similar process to occur in the co-researchers. I believe that sustained reflexivity is critical to revealing dominant paradigms and habitual patterns of thought and behaviour.



Appendix I

Biographies of Co-Researchers: Electronic Dialogue Participants

Two of the co-researchers, Elisabeth Ei and Else Skjonsberg asked to stay involved in my research project following my workshop at the Centre for Policy Alternatives in Oslo, Norway, in December 1995.

Charles Brassard is Director of Consultations at Environment Canada. In this capacity, Charles has been associated with a variety of multistakeholder processes led by Environment Canada and has been instrumental in the development of departmental, federal and national policies and practices in the area of public involvement. His other responsibilities at Environment Canada have included public opinion research, strategic communications, relations with business and non-governmental organizations and environmental citizenship. Charles has worked in the policy field for most of his career. Before joining Environment Canada in 1990, he worked for the Department of External Affairs in the South-East Asia Relations Division, the Privy Council Office in the area of federal-provincial relations, the Canada Oil and Gas Lands Administration and the oil industry. M. Brassard has a Master's Degree in economic geography from the University of Ottawa. He also did his undergraduate studies in geography at the same university.

David Brown is associate professor and Director of the Environmental Policy Institute at Brock University. He received his B.Sc.(Agriculture) in Environmental Biology from Macdonald College of McGill University in 1980. After working as a wildlife biologist for Hydro-Quebec for two years, he entered an M.Sc. program in Renewable Resources (Wildlife) at Macdonald College in 1982. His doctoral degree, dealing with the winter foraging ecology of white-tailed deer, was awarded in 1989. He joined the Environmental Policy Institute (then Institute of Urban and Environmental Studies) at Brock in 1988. He became a full-time faculty member of the Institute in 1991, teaching numerous courses dealing broadly with environmental policy and principles of sustainability, including introductory courses, an honours policy seminar, an honours thesis and literature review course, and half courses dealing with environmental impact assessment, wildlife management and conservation, waste management, environmental toxins, human settlements, and the environmental impacts of the automobile. Current research foci include linear corridors in the environment, trail and greenway development, management and common property aspects of utility corridors, and waste management policy and practice. Major ongoing projects include the Niagara Greenways Network Inventory Project and the Canadian lead in sustainable integrated waste management strategies of the Centre for Industrial and Environmental Training (CIET) initiative, and a 4-year CIDA-funded human resources development project in the eastern seaboard region of Thailand. He is a member of the Lake Ontario Greenway Strategy (LOGS) Steering Committee of the Waterfront Regeneration Trust, and has been on the Board of Directors for the Ontario Trails Council, the Centre for Environmental Training at Niagara College, and Friends of Short Hills Provincial Park (ex officio). He is founder of the Niagara Greenways Network.

Norma Burlington has an honours economics degree from Carleton University and is a career civil servant with an extensive policy background. Over the past twenty three years she has worked for two of these at the Department of Indian and Northern Affairs, ten years at the Department of Finance in the International Economic Relations and Economic Development Divisions, five years at the Canadian International Development Agency as Chief of General Policy in the Business Cooperation Branch, and for the past six years as a Senior Policy Advisor in the Policy Branch and now in the International Affairs Division of the Canadian Forest Service, Natural Resources Canada. Norma's particular expertise is in international trade and development. This year, she received two merit awards from Natural Resources Canada in recognition of her leadership in organizing and directing federal/provincial, industry, ENGO teams for two successful international events, one an international forestry seminar co-hosted with British Columbia and the other the 50th anniversary celebrations of the founding of the FAO in Quebec City.

Stephanie Cairns has worked on environmental policy since 1983. Her most recent work, with the Pembina Institute for Appropriate Development in Alberta, focused on establishing economic incentives for environmental protection, and contributed to changes in the treatment of investments in energy efficiency and renewable energy in the federal income tax system. She has also developed and led training workshops on the principles and tools of sustainable development for the private sector. From 1991 to 1993, she worked as the Sustainable Development Policy Analyst in the National Liberal Caucus Research Bureau, and was the principal drafter of the sustainable development chapter in the 1993 Liberal election platform "Red Book". Prior to this, she worked for a number of environmental organizations and agencies, including the International network of Friends of the Earth, the Organic Food Producer's Association of Canada, the Ontario Environmental Assessment Advisory Committee, the Canadian Environmental Network, the Canadian Environmental Law Research Foundation, and the Ontario Public Interest Research Group. She has a B.A. in environmental policy from the University of Toronto.

She is currently on leave working as an Advisor on Strategic Planning in the Policy and Research Unit of the Prime Minister's Office; pursuing her Master's studies at the University of Lund.

Frank Cosway is a Partnerships Officer with the Pollution Prevention Branch of Manitoba Environment. From June 1991-July 1995, he was the Partnerships Officer with the International Institute for Sustainable Development (IISD) based in Winnipeg. His work included organizing the partnership series, assisting with the partnerships research initiative, providing support services for the development of multistakeholder partnerships at the Institute, representing IISD on several conference program planning committees, hosting VIP visits to the Institute, and undertaking special projects such as the CIDA-China consultation and the Russia-CCME project. Frank attended the Earth Summit Conference in Rio in June 1992. Before coming to IISD, Mr. Cosway was a Senior Planning and Policy Analyst with the Sustainable Development Coordination Unit, Manitoba Executive Council, where he worked on issues dealing with the environment, economy and sustainable development. He coordinated the Environment and Economy Conference held in Winnipeg in May 1989 and the First Meeting of Round Tables on Environment and Economy held in April 1990. In addition, he coordinated six meetings of the Manitoba Round Table on Environment and Economy between November 1989, and June 1991. Prior to that, he was a project manager for the Water Utilization Project, Phase II, Northern Ghana (1985-1987). From 1979-1984, he was a human resource management consultant with Manitoba Industry Trade and Tourism, providing a broad range of services to the private sector in Manitoba. Other international and intercultural experiences include two years as a CUSO volunteer in Ghana, two and a half years living in the aboriginal community of Easterville in Northern Manitoba, also some short term visits and consulting assignments to India, Bangladesh, Colombia, Bolivia, Brazil and Costa Rica.

Ron Edwards is a consultant on taxation and economic development issues. He holds a B.A. from the University of Saskatchewan, and obtained his M.A. in Economics from the University of Alberta in 1970. He has substantial experience in the finance, economic development, and resource taxation fields. After starting his working career in the Bank of Canada, Ron moved to the National Energy Board in 1973 and was in charge of demand forecasting during the Mackenzie Valley Gas Pipeline hearings. He joined the Tax Policy Branch of the Department of Finance in 1977 and held several executive level positions until he left the Government in 1996. These included Assistant Director, Corporate and Resource Taxation, Senior Chief, Energy and Project Analysis, and Director, Energy and Environment Division, Economic Development Policy Branch. Ron represented the Minister of Finance at National Round Table on the Environment and the Economy; was on the Canadian delegation at the Rio Preparatory Conference at Bergen, Norway;

and attended meetings of the Cabinet Committee on Economic Development during considerations of the Green Plan. He also negotiated financial subsidies for several large energy projects, such as Hibernia.

Elisabeth Ele has degrees in Basic Agriculture (1972), Nutrition (1976) and a B.A. in Social Anthropology (1979). Her main work experience has been as a nutrition specialist for WFP, Senegal (1978) and for the International Red Cross, Khmer Refugee Camps, Thailand, 1979. NORAD-employed from 1980-1994; seven years in the NGO division, Oslo, six years as Assistant Residential Representative in Bangladesh and Pakistan, and finally two years as WID and Gender Advisor to NORAD in Oslo. Since August 1994, she has been employed as the Executive Director of FOKUS - Forum for Women and Development. Her main field of interest has always been indigenous peoples groups, women's perspectives and feminine/holistic values in relation to management of life and nature (sustainable development). In addition to experiences from project management and dialogue, her international work has put her in touch with women and indigenous peoples at the local level in many parts of the world, as well as at a wider national, regional and international activist level.

Caterina Geuer was born into a Dutch family of artists and human-rights activists in Bolivia, South America. After obtaining a B.A. at Carleton University in Ottawa in 1969, she designed and taught a course on environmental and human rights issues, following which she spent several years traveling in Europe, Africa and India. Upon her return, she was involved in the natural food business, running a store and bakery, teaching classes on cooking and nutrition, and catering, particularly for people struggling with immune system malfunctions. In addition, Ms Geuer has studied the relationships between the health of the ecosystems and the health of the human species in general; midwifery and palliative care in particular. By 1992, she changed her focus from working with individuals to working in systems, and started working with the Sierra Club of Canada and Cultural Survival Canada. She was a member of the Steering Committee for the Women and Sustainable Development: Canadian Perspectives Conference, and edited the final policy document. Presently, she is the Volunteer Coordinator at the David Suzuki Foundation. She intends to use her talents and experience to participate in the vital task of changing our behaviour as a species so that we may continue to live on the Earth together with all the other species in a regenerative, bio-centric way.

Suzanne Hawkes has a Master's degree in Natural Resources Management from the School of Resource and Environmental Management at Simon Fraser University, and a Bachelor's degree (Honours) in Environmental Studies from the University of Waterloo. As a researcher and consultant, her work has focused on diverse issues concerning social justice and environmental responsibility. These include the concerns of Inuit women regarding the Great Whale hydroelectric project in northern Quebec, the impacts of the James Bay I dam on the Cree village of Chisasibi, Quebec, the development of co-management with the Haida Nation and Canada in the protected area of Swaii Haanas, and the state of Canadian law with respect to ship-source oil pollution. She also co-authored the Greening of Tourism. Suzanne is currently the Project Manager at the David Suzuki Foundation, an environmental non-profit organization based in Vancouver. Her work there involves communications, strategic planning, fundraising and designing and overseeing a variety of projects, on issues ranging from forestry and fisheries to social change and ecological economics. She is 32 years old, and lives in Vancouver near the ocean with her partner of 12 years.

Sally Lerner teaches in the Department of Environment and Resource Studies and was Chair of that department from 1994 through June 1996, when she became an Adjunct Professor after taking early retirement. She was a member of the transdisciplinary group of professors who joined together in 1969-70 at the University of Waterloo to initiate the department, one of the first undergraduate environmental studies departments in North America. Her major research interest for the past several years has been the future of work in a globalizing economy driven by technological change, particularly the social, political, environmental and economic issues involved. She will devote substantial time to research and advocacy in this area as her major retirement project. Sally was Acting Director of the UW Centre for Society, Technology and Values for 1995-96 and was a member of the Board of Directors of Great Lakes United from 1993-1996. In recent years she has served on the Outside Jury for the Seaton Design Competition (Seaton: A Strategy for Environmentally-Responsible Planning, Ontario Ministry of Housing, 1994). She has also been Canadian Co-Chair, Board of Technical Experts, Social Science Task Group, Great Lakes Fisheries Commission, 1991-93 and a member of the International Joint Commission's Task Force on the Virtual Elimination of Persistent Toxic Substances from the Great Lakes, 1992-94. In the research field, she was one of three Principal Co-Investigators on the SSHRC-funded Sustainable Society Project, 1988-91.

Nina-Marie Lister holds a Master of Science degree in Environmental Planning from the University of Toronto and is a consulting ecologist/planner. She is currently completing a Ph.D. in conservation ecology and planning at the University of Waterloo, Faculty of Environmental Studies. Nina-Marie's research is centred on developing planning policy for biodiversity conservation in Canada, within the larger context of sustainable ecosystem management. Her dissertation focuses on the development of adaptive planning strategies for biodiversity and ecosystem integrity, using an approach based on post-normal science. Related research interests include ecosystem behaviour, emergent complex systems, and ecologically responsible planning/design. Nina-Marie holds an Eco-Research Doctoral Fellowship, funded by the Canadian Tri-Council.

Christine Massey is currently Project Manager at the Sustainable Development Research Institute at the University of British Columbia, where she is responsible for a wide range of communication, management and financial functions. She holds a BA in Communication and Political Science from the University of Ottawa and a Master's degree in Communication from Simon Fraser University. Her thesis research focused on public involvement in science and technology policy and specifically, the case of the Royal Commission on New Reproductive Technologies. She has worked as a consultant and researcher on science policy in Canada and the communication of environmental and health issues to the public. As an activist, Christine has worked on issues of women's reproductive health and the new biotechnologies.

John Middleton is a Professor with the Environmental Policy Institute at Brock University. He studies the human element in ecosystems and the implications of government and other policies for sustainable development. His work has concentrated on interdisciplinary study and development of policy for forests and urban landscapes at scales from local to global, in Canada and in other countries.

Laszlo Pinter is currently Program Officer with the Measurement and Indicators Program at the International Institute for Sustainable Development. He holds an M.Sc. in agronomy from the Godollo University of Agricultural Sciences, Hungary, and an M.N.R.M. from the University of Manitoba. Laszlo's current interests include performance measurement in the context of sustainable development, future scenario analysis and adaptive behaviour in complex systems.

Shealagh Pope holds a Master's degree in Biology-Landscape Ecology at Carleton University . Her thesis evaluated the effects of habitat fragmentation on species that require more than one kind of habitat. As well as working on her Master's degree over the last few years, she has worked on a project to analyze the relative effects of temperature change on North Atlantic cod using a combination of statistical analysis and computer modeling. Ms Pope has helped to found a new on-line journal, Conservation Ecology, in cooperation with Lenore Fahrig and Gray Merriam at Carleton and Phil Taylor at Acadia. She is currently the project manager for the journal, Conservation Ecology. She has worked on broadening the publication from simply a scientific journal to a policy forum and distributed learning centre at the interface of conservation, ecology and policy. In keeping with her interests in landscape ecology and land use, she has been helping to frame a project to ensure connectivity between Algonquin Park, Ontario and the Adirondaks in New York for species other than humans.

Dale Rothman was born in Louisville, Ky. He is currently a Post-Doctoral Fellow with the Environmental Adaptations Research Group of Environment Canada and the Sustainable Development Research Institute at the University of British Columbia. He has a Ph.D. in Resource and Environmental Economics from Cornell University and a B.Sc. in Earth & Planetary Sciences from MIT. He also did masters work at the Institute of Environmental Studies at the University of Wisconsin, spent a summer at the International Institute for Applied Systems Analysis, and has worked with the US Environmental Protection Agency, Argonne National Laboratory, and the World Resources Institute. His general area of interest is the link between natural and human systems, and his current specific research areas include the socio-economic impacts of climate change on forests, the nature and role of integrated assessment, and the relationships between economic growth and environmental degradation.

David Sims is a Professor of Veterinary Medicine (Microanatomy) at the Atlantic Veterinary College, University of Prince Edward Island. He has a Ph.D. from Kansas State University, a M. Engineering from the University of Western Ontario (Biological Indicators of Water Pollution) and a B.A. in Zoology from the University of Western Ontario. He sits on a number of professional committees and advisory boards - the DVM Awards Committee, Atlantic Veterinary College, Member of the UPEI Board of Governors & Faculty Association, Joint Committee on Pension and Benefits, Vice-President, UPEI Faculty Association, Chair, AVC World Wide Web Working Group, Member, AVC Continuing Education Committee, Member AVC Exhibits Committee, and Chair, UPEI President's Sexual Harassment Committee. Dr. Sims has written one book, thirty refereed articles, twenty three abstracts and sixteen other papers, in addition to refereeing numerous manuscripts and reviewing research proposals.

Else Skjonsberg is a Special Advisor, Program for Research and Documentation for a Sustainable Society with the Norwegian Research Council. She has a Ph.D. in Sociology and an M.A. in History (majoring in philosophy and psychology) from the University of Oslo. From 1978 to 1985, Dr. Skjonsberg was a consultant to Women in Development Consulting Norway (WIDCO). From 1978 to 1985, she was a Senior Programme Officer with the Norwegian Agency for International Development. In 1977-78, she was a rural sociologist on the Intensive Zone Development Project, Government of Zambia; 1974-46, a Research Fellow with the Peace Institute of Oslo; 1973-74 a rural sociologist in Sri Lanka; 1972-73, a lecturer with the Institute of Sociology, University of Oslo; 1970-72, a fisheries sociologist with the East African Freshwater Fisheries Research Organization, Uganda; and in 1970, a junior lecturer with the Institute for Sociology, University of Oslo. Her fields of specialization include gender issues, fisheries, rural and community development, environment protection, health issues, participatory development, project identification, planning and evaluation, research planning and evaluation, and European Union issues. Dr. Skjonsberg has worked in Kenya, Tanzania, Bangladesh, Sri Lanka, Thailand, India, Pakistan, Uganda, Zambia, Zimbabwe, Malawi, Madagascar, Botswana, Lesotho, Swaziland, Ghana, Guinea Bissau and Senegal. Her most recent publications include The Rationality of Care, Women and the European Community Cappelen and Cappelen's Women' History, Change in An African Village - Kefa speaks and A Special Caste - Tamil Women in Sri Lanka.

Arja Vainio-Mattila is an Assistant Professor of International and Comparative Studies at Huron College, University of Western Ontario. She has a doctorate in geography from the University of Turku, Finland. Prior to coming to Canada in 1993, and to a lesser degree since, she has worked in the area of community based natural resource management and participatory development in Africa, Asia and Europe. Most of her work is related to how a community's opportunities to relate to the natural resources (water, forests) that their subsistence depends on are affected by development. She approaches this issue from a social justice perspective questioning power relations and the location of power focusing on gender as a fundamental dimension of the approach.

Appendix J

Federal Government Peer Review

Most of these people are colleagues who have worked with me over the course of my 22 years as an Executive with the Federal Government. They were selected on the basis that they would have some personal commitment to my research, as well as reflect a diversity of experiences from a number of organizational perspectives. Most importantly, they were also selected on the basis of their influence in the particular spheres in which they work. A copy of Chapters 8, 9 and 10 were sent to them, asking for their comments, and they were assured that no personal attributions would be made in any of my discussions.

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Appendix K

Definitions of Key Terms used in this Dissertation

Allogenic succession (allo=outside, genic=relating to), and internally gene-rated sequences as **autogenic** succession (auto=self-propelling) or autogenic development. (Odum 1975)

Biomass: in an inventory sense the weight of organisms (producers, consumers, decomposers) present at any one time is conveniently termed biomass (=living weight) or standing crop. The size of the standing crop is not necessarily indicative of the level of activity; some ecosystems, such as a forest of large trees, have a large amount of relatively inert biomass (Odum 1975).

Biodiversity is the totality of genes, species, and ecosystems within a region. The wealth of life on earth today is the product of hundreds of millions of years of evolutionary history. Over the course of time, human cultures have emerged and adapted to local environments, discovering, using, and altering their biotic resources. Many areas that now seem 'natural' bear the marks of millennia of human habitation, crop cultivation, resource harvesting, and waste production. The domestication and breeding of local varieties of crops and livestock have further shaped biodiversity.

For convenience, biodiversity can be divided into three hierarchical categories: genes, species, and ecosystems. These describe quite different aspects of living systems and scientists measure them in different ways.

Genetic diversity refers to the variation of genes within species. There occur distinct populations of the same species, such as thousands of traditional rice varieties in India, and genetic variation within a single population, which is very high among Indian rhinos, for example, and very low among cheetahs. Until recently, measurements of genetic diversity were applied mainly to domesticated species and populations held in zoos and botanical gardens, but increasingly these techniques are also being applied to wild species.

Species diversity refers to the variety of species within a region. Such diversity can be measured in many ways, and scientists have not yet settled on the best methods. The number of species in a region -- its species 'richness' -- is one often used measure, but a more precise measurement, 'taxonomic diversity,' also considers the relationship of species to one another. An island with two species of birds and one species of lizard, for example, has greater taxonomic diversity than an island with three species of birds and no lizards.

Ecosystem diversity is harder to measure than species or genetic, diversity because the 'boundaries' of communities -- associations of species -- and of ecosystems are elusive. Nevertheless, as long as a consistent set of criteria is used to define communities and ecosystems, their number and distribution can be measured. Until now, such schemes have been applied mainly at national and subnational levels, although some coarse global classifications have been proposed.

Many other expressions of biodiversity can be important. These include the relative abundance of species, the age structure of populations, the pattern of communities within a region, changes in community composition and structure over time, and ecological processes such as predation, parasitism, and mutualism. To meet specific management and policy goals, it is crucial to examine not only compositional diversity -- genes, species, and ecosystems -- but also diversity in ecosystem structure and function.

Human cultural diversity could be considered part of biodiversity. Like genetic and species diversity, some attributes of human cultures, such as nomadism and shifting cultivation, represent 'solutions' to the problems of survival within particular environments. Like other aspects of biodiversity, cultural diversity helps people adapt to changing conditions. It is evident within language, religious beliefs, land management practices, art, music, social structure, crop selection, diet, human relationships, and numerous other attributes of human society (modified from the Global Biodiversity Strategy 1992).

The composition and levels of biodiversity (UNEP 1995).

Ecological diversity	**Genetic diversity**	**Organismal diversity**
biomes		kingdoms
bioregions		phyla
landscapes		families
ecosystems		genera
habitats		species
niches		subspecies
populations	populations	populations
	individuals	individuals
	chromosomes	
	genes	
	nucleotides	

Cultural diversity: human interactions at all levels (see above under Biodiversity).

Biosphysical carrying capacity is the maximum population size that an area can sustain under given technological capabilities (Daily and Ehrlich 1996).

Biosphere is a widely used term for all of the earth's ecosystems functioning together on the global scale. Or, from another viewpoint, we can think of the biosphere as being that portion of the earth in which ecosystems can operate--that is, the biologically inhabited soil, air, and water. The biosphere merges imperceptibly (that is, without sharp boundaries) into the lithosphere (the rocks, sediments, mantle, and core of the earth), the hydrosphere, and the atmosphere, the other major subdivisions of our earth spaceship.

Finally, it should be emphasized that, as with any spectrum, the levels-of-organization hierarchy is a continuous one; divisions are arbitrary and set for convenience and ease of communications (Odum 1975).

Carrying capacity is the population level for long-range survival (Odum 1971). Two levels are typically recognized: the maximum or subsistence density, or the maximum number of individuals that can eke out an existence in the habitat, and the optimum or "safe" level, a lower density at which individuals are more secure in terms of food, resistance to predators, and periodic fluctuations in the resource base (Odum 1989). Since humans can vary widely in their impact on life-supporting resources, social scientists add a second dimension, intensity of use, to their concept of carrying capacity. Catton (1987) defines carrying capacity as the *volume and intensity of use that can be sustained without degrading the environment's future suitability for that use.*

Ecologists define **carrying capacity** as the population of a given species that can be supported indefinitely in a defined habitat without permanently damaging the ecosystem upon which it is dependent. However, because of our culturally variable technology, different consumption patters, and trade, a simple territorially-bounded head-count cannot apply to human beings. Human carrying capacity must be interpreted as the maximum rate of resource consumption and waste discharge that can be sustained indefinitely without progressively impairing the functional integrity and productivity of relevant ecosystems wherever the latter may be. The corresponding human population is a function of per capita rates of material consumption and waste output or net productivity divided by per capita demand (Rees 1990). This formulation is a simple restatement of Hardin's (1991) Third Law of Human Ecology: total human impact on the ecosphere=population x per capita impact (Wackernagel and Rees 1996).

Early versions of this law date from Ehrlich and Holdren who also recognized that human impact is a product of population, affluence (consumption) and technology I=PAT (Ehrlich and Holdren 1971; Holdren and Ehrlich 1974).

Co-evolution involves reciprocal natural selection between two or more groups of organisms with close ecological relationships, but without exchange of genetic information between the groups (without interbreeding). Ehrlich and Raven (1965), who first proposed the term, used their studies of butterfly caterpillars and plants as a basis for proposing the hypothesis as follows. Plants, through occasional mutations and gene recombination, produce chemical compounds, perhaps as waste products, which are not harmful to a plant, but turn out to be poisonous to an insect herbivore such as a caterpillar. Such a plant, now protected from the herbivore, would thrive, and would pass on the favourable mutation to successive generations. Insects, however, are quite capable of evolving strains tolerant to poisons--as is dramatically shown by the increasing number of insects that become immune to insecticides. If a mutant or recombinant appeared in the insect population that allowed individuals to feed on the previously protected plant, selection would favour that genetic line. In other words, the plant and the herbivore evolve together, in the sense that the evolution of each depends on the evolution of the other. Pimentel (1968) has used the expression **genetic feedback** for this kind of evolution, which he demonstrated experimentally with flies and wasps. Norgaard (1994) used it to emphasize the need for (Figure 5.1) to be taken into account equitably in sustainable development.

Ecology: the study of the earth's "households" including the plants, animals, microorganisms, and people that live together as interdependent components. Because ecology is concerned not only with organisms, but with energy flows and material cycles on the lands, in the oceans, in the air, and in fresh waters, ecology can be viewed as "the study of the structure and function of nature"--it is understood that mankind is a part of nature (Odum 1975).

In ecology the term **population**, originally coined to denote a group of people, is broadened to include groups of individuals of any kind of organism. Likewise, **community** in the ecological sense (sometimes designated as biotic community) includes all of the populations of a given area. The community and the non-living environment function together as an **ecological system or ecosystem** (Ibid).

Ecosystem: a collection of interacting biological entities combined with the physical environment in which they live, which is perceived to act as a whole (Woodley et al. 1993).

The **ecosystem**, or ecological system, is considered to be a unit of biological organization made up of all of the organisms in a given area (that is, the "community") interacting with the physical environment so that a flow of energy results in a characteristic trophic structure and material cycles within the system (Odum 1975).

An important consequence of hierarchical organization is that as components, or subsets, are combined to produce larger functional wholes, new properties emerge that were not present or not evident at the level below. Accordingly, an **emergent property** of an ecological level or unit is one that results from the functional interaction of the components, and therefore is a property that cannot be predicted from the study of the components that are isolated or decoupled from the whole unit (Salt 1979).

It is convenient to recognize four constituents as comprising the ecosystem: (1) **abiotic** substances and conditions of existence, basic elements, compounds, and climatic regimes of the environment; (2) **producers**, the autotrophic organisms, largely green plants; (3) the large **consumers or macroconsumers**, heterotrophic organisms, chiefly animals, that ingest other organisms or particulate organic matter; and (4) the **decomposers or microconsumers**, heterotrophic organisms, chiefly the bacteria and fungi that break down the complex compounds of dead protoplasm, absorb some of the decomposition products, and release simple mineral nutrients usable by the producers as well as organic components which may provide food or which may be stimulatory (e.g., vitamins) or inhibitory (e.g., antibiotics) to other organisms (Odum 1975).

It is also convenient to subdivide the non living or abiotic portion of an ecosystem into three components: (1) **inorganic substances**, the carbon, nitrogen, water, and so on that are involved in the material cycles of the ecosystem; (2) **organic substances**, the carbohydrates, proteins, lipids, humic substances, and so on that link abiotic and biotic; and (3) the **climate regime**, temperature and other physical factors that delimit the conditions of existence.

When considered from the ecosystem point of view, a lake, a forest, or other recognizable unit of the landscape has two biotic components: an **autotrophic** component (autotrophic means "self-nourishing"), able to fix light energy and manufacture food from simple inorganic substances and, secondly, a **heterotrophic** component (heterotrophic means "other nourishing") which utilizes, rearranges, and decomposes the complex materials synthesized by the autotrophs. These functional components are arranged in overlapping layers with the greatest autotrophic metabolism occurring in the upper "green belt" where light energy is available, and the most intense heterotrophic activity taking place in the lower "brown belt" where organic matter accumulates in the soils and sediments (Odum 1975).

The diversity of species tends to increase with succession. Maximum diversity of autotrophs in many ecosystems seems to be reached earlier in succession. **A decrease in net community production and a corresponding increase in community respiration are two of the most striking and important trends in succession** (Odum 1975).

Ecosystem integrity encompasses three major ecosystem organizational facets. Ecosystem health, the ability to maintain normal operations under normal environmental conditions, is the first requisite for ecosystem integrity. But it alone is not sufficient. To have integrity, an ecosystem must also have the resilience with changes (which can be catastrophic) in environmental conditions; that is, it must be able to cope with stress. As well, an ecosystem that has integrity, must be able to continue the process of self-organization on an ongoing basis. It must be able to continue to evolve, develop, and proceed with the birth, growth, death and renewal cycle (Kay 1994).

Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and help to fulfill human life. They maintain biodiversity and the production of ecosystems goods, such as seafood, forage, timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products, and their precursors. The harvest and trade of these goods represent an important and familiar part of the human economy. In addition to the production of goods, ecosystem services are the actual life-support functions, such as cleansing, recycling, and renewal, and they confer many intangible aesthetic and cultural benefits as well (Daily 1997).

Governance is a social function crucial to the viability of all human societies. It centres on the management of complex interdependencies among many different actors -- individuals, corporations, interest groups, nation states -- involved in interactive decision-making that affect each other's welfare (Young and von Moltke 1993).

Government is the acts, rules, procedures, instruments of power and institutions by which the citizens of a country (or more generally the parts of a system) communicate with and exert control upon each other so that the country as a whole maintains its unity and is directed toward ends chosen from within that country (Krippendorff 1997).

Population: group of the same species within a defined area. In practice, a population is simply all of the organisms of the same species found occupying a given space. A population, as with any level of organization, has a number of important group properties not shared by adjacent levels (the organism, on the one hand, and the community on the other). The most important of these population characteristics, or group attributes, are as follows:

Density: population size in relation to a unit of space.

Birth rate, or more broadly, natality (so as to include organisms that arise from seeds, spores, eggs, and so on): the rate at which new individuals are added to the population by reproduction.

Death rate or mortality: the rate at which individuals are lost by death.

Dispersal: the rate at which individuals immigrate into the population and emigrate out of the population.

Population growth rate or growth form: the net result of natality, mortality, and dispersal.

Dispersion: the way in which individuals are distributed in space, generally in one or more of the following three broad patterns: (1) random distribution, in which the probability of an individuals occurring in any one spot is the same as the probability of it occurring at any other spot; (2) uniform distribution, in which components occur more regularly than random, such as corn in a cornfield; or (3) clumped distribution (the most common in nature), in which individuals or other components are more irregular than random, as for example, a clump of plants arising from vegetative reproduction, a flock of birds, or people in a city.

Age distribution: the proportion of individuals of different ages in the group.

Genetic characteristics: especially applicable to population ecology, as for example, adaptiveness, reproductive (Darwinian) fitness, and persistence (that is, probability of leaving descendants over long periods of time) (Odum 1975).

Primary production or **primary productivity** are terms for the amount of organic matter fixed (converted from solar energy) by autotrophs in a given area over a given period of time, generally expressed as a rate, so much per day or year. **Gross primary production** is the amount stored in a plant for its own needs, while **net primary production** is the amount stored in a plant in excess of its respiratory needs and therefore, potentially available to heterotrophs. **Net community production** is the amount left after the biotic community, autotrophs and heterotrophs, have taken all the food they need (Odum 1989).

Social carrying capacity is the maximum human population size that an area can sustain under a given social system, with particular reference to associated patterns of resource consumption (Daily and Ehrlich 1996).

The word **system** is used in the primary dictionary sense as "a regularly interacting or interdependent group of items forming a unified whole" (Odum 1975). **Systems** are groups of interacting, interdependent parts linked together, by exchanges of energy, matter, and information. Complex systems are characterized by strong (usually non-linear) interactions between the parts, complex feedback loops that make it difficult to distinguish cause from effect, and significant time and space lags, discontinuities, thresholds, and limits (Costanza et al. 1973).

Succession, the way complexes of plants develop sequentially over time after a disturbance. Clements (1916) emphasized that succession led to a climax community of a self-replicating assemblage of plants. The species comprising that assembly are determined by basic climatic conditions - precipitation and temperature. Plant colonization and growth were seen as proceeding in a sequence leading to the stable climax. Initial colonization was by pioneer species that could grow rapidly and withstand extremes of physical conditions. They so ameliorated those conditions as to allow entry of less robust but more competitive species. Those species in turn inhibited the pioneers but set the stage for their own replacement by still more effective competitors. Throughout this process, biomass accumulates, regulation of biological, physical and chemical processes becomes tighter and variability is reduced until the stable climax condition is reached and maintained.

Ecosystem development (succession) as an autogenic process may be defined in terms of the following three parameters: (1) it is the orderly process of community changes which are directional and, therefore, predictable, (2) it results from the modification of the physical environment and population structure by the community, (3) and it culminates in the establishment of as stable an ecosystem as is biologically possible on the site in question. It is important to emphasize that this kind of ecological change is community controlled; each set of organisms changes the physical substrate and the microclimate (local conditions of temperature, light, and so on), and species composition and diversity is altered as a result of competitive and other population interactions (Odum 1975).

Stability (sensu strictu) concerns the propensity of a system to attain or retain an equilibrium condition of steady state or stable oscillation. Highly stable systems resist the departure from that condition and, if perturbed away from it, return rapidly to it with the least fluctuation. This is a classic equilibrium-centered definition (Holling 1984).

Resilience is the ability of a system to maintain its structure and patterns of behaviour in the face of disturbance. Size of the stability domain of residence, strength of the repulsive forces at the boundary and resistance of the domain to contraction are all distinct measures of resilience (Holling 1984).

By **robust** I mean that there is so much functional diversity and spatial heterogeneity in the keystone structuring set of processes that their regulatory role retains its integrity in the face of great changes in populations of the keystone set species or in values of the keystone physical variables (Holling 1993).

The first law of **thermodynamics** was partially stated by Helmholtz (1847) and more formally by Thomson in 1851:

Energy can be transformed from one type to another ,but it can never be created nor destroyed.

The second law was first stated by Carnot (1824):

No transformation of energy can occur unless energy is downgraded from a concentrated to a more dispersed form and no transformation is 100% efficient. (Jenkins. nd. Making our Ecological Niche)

Appendix L

Policy Alternatives

These examples are included as illustrations of the wealth of literature available on alternatives to the dominant paradigms, that have been systematically ignored by mainstream political and policy agendas.

Principles for the Conservation of Wild Living Resources (Mangel et al. 1996)

Principle I. Maintenance of healthy populations of wild living resources in perpetuity is inconsistent with unlimited growth of human consumption of and demand for those resources.

Recognize that the total impact of humans on wild living resources is the product of human population size, per capita consumption, the impact on the resource of the technologies applied, and incidental taking and habitat degradation caused by other human activities. Take appropriate actions that recognize these characteristics.

Recognize that if urban areas and other intensely used land areas were more efficient, safer, and more pleasant, there would be a greater chance of conserving wild living resources.

Principle II. The goal of conservation should be to secure present and future options by maintaining biological diversity at genetic, species, population, and ecosystem levels; as a general rule neither the resource nor other components of the ecosystem should be perturbed beyond natural boundaries of variation.

Manage total impact on ecosystems and work to preserve essential features of the ecosystem

Identify areas, species, and processes that are particularly important to the maintenance of an ecosystem, and make special efforts to protect them.

Manage in ways that do not further fragment natural areas.

Maintain or mimic patterns of natural processes, including disturbances, at scales appropriate to the natural system.

Avoid disruption of food webs, especially removal of top or basal species.

Avoid significant genetic alteration of populations.

Recognize that biological processes are often nonlinear, are subject to critical thresholds and synergisms, and that these must be identified, understood, and incorporated into management programs.

Principle III. Assessment of the possible ecological and sociological effects of resource use should precede both proposed use and proposed restriction or expansion of ongoing use of a resource.

Identify uncertainties and assumptions regarding natural history, size, and productivity of the resource and its role in the ecosystem.

Identify major ecological and socio-economic uncertainties and assumptions.

Analyze how the resource and other ecosystem components might be affected by the proposed use if the assumptions are not valid.

When available information is insufficient to make informed judgments, authorize activities contingent upon development and approval of an information-acquisition plan that will ensure that the level of resource use does not increase faster than does knowledge of the size and productivity of the resource and its relationships with other ecosystem components.

Require those most likely to benefit directly from use of a wild living resource to pay the costs of (a) developing the information-acquisition plan, (b) implementing the information-acquisition plan and (c) managing use of the resource. Only when the general public receives notable benefit is it appropriate for public monies to pay the costs.

Be prepared for unexpected events because the natural world is highly complex and stochastic, and human understanding of it always contains uncertainty.

Principle IV. Regulation of the use of living resources must be based on understanding the structure and dynamics of the ecosystem of which the resource is a part and must take into account the ecological and sociological influences that directly and indirectly affect resource use.

Allocate the use of wild living resources on the basis of the ecological capabilities of the species involved and their assessed value to society.

Provide incentives to the users of living resources that correspond to the value those resources have to society. Ensure that these incentives promote conservation, and constrain all privilege of access to guarantee this.

Ensure that institutions and property rights are consistent with conservation, including questions of tenure and access.

Protect the welfare of future generations by ensuring that the value of biotic and abiotic resources does not decrease over time.

Recognize the possible consequences of uncertainty and act accordingly.

Promote adaptive management.

Principle V. The full range of knowledge and skills from the natural and social sciences must be brought to bear on conservation problems.

Invoke the full range of relevant disciplines at the earliest stage possible.

Recognize that science is only one part of living-resource conservation and is limited to investigating and objectively describing certain kinds of phenomena and processes.

Require comprehensive consultations because virtually all conservation issues have biological, economic, and social implications; ignoring any of these may lead to conflicts that will impair effective conservation.

Principle VI. Effective conservation requires understanding and taking account of the motives, interests and values of all users and stakeholders, but not by simply averaging their positions.

Whenever possible, create incentives by delegating property rights to the "lowest" relevant community or societal level consistent with the scale of the resource involved.

Develop conflict-resolution mechanisms to minimize strife over resources among competing stakeholders.

Ally science with policy making independent of the interests of resource users.

Require that policy makers be held accountable for the use of the best possible data and analyses in setting policy.

Insofar as possible, establish agreed-upon criteria and procedures to guide decision-making on conservation measures at all levels, in order to reduce the scope for influence by political or special interests.

Ensure that formal institutions responsible for giving expression to policies and implementing conservation programs have temporal and spatial perspectives consistent with the ecological character of the resources and organizational structures that are (1) flexible and problem-oriented; (2) accountable, visible, and performance-oriented with clear, measurable, and explicit objectives; (3) team-oriented, participatory, and interdisciplinary, employing consensual decision-making; and (4) capable of learning and corrective feedback (i.e., are adaptive).

Principle VII. Effective conservation requires communication that is interactive, reciprocal, and continuous.

Ensure that communication is targeted to the audience and is based on mutual respect and sound information.

Require internal and external review to verify objectivity and results.
Inform and motivate the public and motivate regarding conservation.
Develop institutions and procedures to facilitate transdisciplinary analysis and communication that informs decision makers.

http://www.ecouncil.ac.cr/value/principl/princeng.htm (also available in French and Spanish)

Principles of Environmental Conservation and Sustainable Development: Summary and Report
A study in the Field of International Law and Related International Reports
Prepared for the Earth Charter Project
by Steven C. Rockefeller

INTRODUCTION

The summary overview and the survey of principles of environmental conservation and sustainable development contained in this report have been prepared as an aid and resource in support of the endeavor to identify the core values and principles that should be considered for inclusion in an Earth Charter. These materials are designed to identify and clarify the major principles of environmental conservation and sustainable development that have been formulated to date in international law and related reports and documents. The survey shows that a significant worldwide consensus is emerging around a number of basic principles among legal experts, government leaders, and NGOs, and at the United Nations.

In its 1987 report to the United Nations, Our Common Future, the World Commission on Environment and Development (WCED) recommended creation of a new charter or universal declaration on environmental protection and sustainable development.

SUMMARY OF PRINCIPLES

I. The Goal: A Global Partnership

The general objective of international environmental and sustainable development law is formation of a global partnership of all peoples and nations to ensure for present and future generations the well-being of humanity and the larger community of life by promoting equitable and sustainable development and by protecting and restoring the health and integrity of the Earth's biosphere, of which all life is a part and apart from which humanity cannot survive or realize its creative potential. This global alliance should be founded on commitment to an integrated framework of shared ethical principles and practical guidelines.

II. Preamble: The Human Situation

The environmental and developmental problems facing humanity involve a complex of interrelated issues including: increasing degradation of the global environment, deterioration and depletion of natural resources, excessive consumption, rising population pressures, perpetuation of disparities between and within nations, poverty, pollution, ignorance, injustice, and armed conflict. The decisions and choices humanity makes in response to the challenge of these critical problems will have major consequences for the future of life on Earth. Humanity stands at a defining moment in its history.

III. World View

1. The biosphere is a unity, a unique and indivisible ecosystem, and all of its diverse constituent parts are interdependent.

2. Humanity is part of nature and the community of life, and all life depends for survival and well-being on the functioning of natural systems.

3. Every life form is unique and possesses intrinsic value independent of its worth to humanity. Nature as a whole and the community of life warrant respect.

IV. A Common Concern and Universal Responsibility

1. The well-being of the community of life and the protection of the environment are a common concern of humanity.

2. Nature as a whole, the Earth, and all life forms should be respected. All persons have a fundamental responsibility to respect and care for the community of life.

3. Protect, preserve, and, insofar as possible, restore the health and integrity of ecosystems, ensuring the functioning of essential ecological processes and life support systems throughout the Earth.

a. Provide special protection to fragile ecosystems such as are found in deserts, semi-arid lands, mountains, wetlands, and certain coastal areas and on small islands.

4. Conserve biodiversity including the diversity of species, the range of genetic stocks within each species, and the variety of ecosystems.

a. Provide special protection to endangered species and their habitats.

V. The Rights of People

1. All human beings, including future generations, have a right to an environment adequate for their health, well-being, and dignity, and the responsibility to protect the environment.

2. All persons, without being required to prove an interest, have the right to seek, receive, and disseminate information on activities or measures that are likely to have environmental impact and the right to participate, individually or collectively, in relevant decision-making processes.

3. All peoples have a right to their economic, social, political and cultural development and a responsibility to adopt sustainable patterns of development.

4. All human rights and fundamental freedoms are interdependent and indivisible.

VI. Sustainable Development

1. The purpose of development is to meet the basic needs of humanity, improve the quality of life for all, and ensure a secure future.

2. All humanity has the duty to integrate environmental conservation with development activity at all stages and levels so as to achieve sustainable development, keeping human resource use and related activity within the limits of the carrying capacity of supporting ecosystems. Sustainable development promotes the well-being of both people and ecosystems.

3. Protection of the environment is best achieved by preventing environmental harm rather than by attempting to remedy or compensate for such harm.

a. Activities which are likely to cause irreversible environmental change or damage should be avoided altogether.

4. Activities which are likely to cause potential or actual harm to the environment shall be preceded by a thorough environmental impact assessment.

5. Precautionary Principle: In situations where there is the risk of irreversible or serious damage to the environment, lack of full scientific certainty shall not be used as reason to postpone action to avoid potentially irreversible or serious harm to the environment.

6. The development and implementation of appropriate demographic policies, ensuring that human population levels remain within the carrying capacity of the Earth, are necessary to improve the quality of life for all people and to protect the environment.

7. The elimination of unsustainable patterns of production and consumption is essential and requires adoption of the following measures.

a. Minimize the depletion of non-renewable resources. b. Ensure all renewable resources are used sustainably. c. Use all resources with restraint and as efficiently as possible. d. Develop and adopt technologies that increase energy efficiency. e. Develop and adopt technologies that use renewable resources to generate energy. f. Prevent, reduce, and control pollution. g. Minimize waste: reduce the volume of materials used, reuse, recycle.

8. Governments, businesses and other organizations should cooperate in promoting the development and adoption of environmentally sound technologies.

9. Policy makers should adopt a system of economic indicators for measuring economic health and development that reflects the full social and environmental cost of human activities, thereby integrating environmental and economic measures.

10. The prices of commodities and raw materials should reflect the full direct and indirect social and environmental costs of their extraction, production, transport, marketing, and, where appropriate, ultimate disposal.

11. Peace and security, environmental protection, sustainable development, and respect for human rights and fundamental freedoms are interdependent and indivisible.

VII. Equity and Justice

1. Intergenerational Equity: Each generation has a responsibility to recognize limits to its freedom of action in relation to the environment and to act accordingly with appropriate care and restraint so that future generations inherit a world that meets their needs.

2. The achievement of sustainable development requires creation of a just and equitable international economic system which ensures that the costs and benefits arising from the use of natural resources are shared fairly among the nations, between rich and poor, and between present and future generations.

3. The eradication of poverty is an ethical imperative and an essential requirement for sustainable development and environmental protection.

4. The particular situation and needs of developing countries, especially of the least developed and most environmentally vulnerable, is a high priority, and the developed countries bear a special responsibility to provide essential financial, scientific, technical, and legal assistance in support of the developing countries' pursuit of environmental conservation and sustainable development.

5. States should cooperate with other nations in establishing joint research efforts for developing environmentally sound technologies and facilitate the transfer of such technologies, strengthening national capacities and accelerating the transition to sustainable development throughout the world.

6. Equality and equity between women and men and the full participation of women in all spheres of social, cultural, economic, and political life, including management decision-making, are essential to the achievement of environmental conservation and sustainable development.

7. The identity, culture, and interests of indigenous peoples, and especially their traditional approaches to sustainable development, should be respected and supported. Indigenous peoples have the right to control their lands, territories and natural resources, and they should be provided opportunities to participate in decision-making processes that are likely to affect their interests in the area of environment and development.

VIII. Governance and Security

1. All States have (a) the sovereign right to utilize their resources to meet their sustainable development needs and (b) the responsibility to develop and implement a national plan for the protection and preservation of the environment within the levels of their national jurisdiction, and to ensure that activities within their jurisdiction or control do not cause potential or actual harm to the environment of other States or areas beyond the limits of national jurisdiction.

2. In view of the different contributions to global environmental degradation and differences in financial and technological resources, States have common but differentiated responsibilities. Accordingly, the developed countries acknowledge the responsibilities that they bear in the international pursuit of sustainable development.

3. Transparent and accountable governance and the democratic participation of all concerned persons in decision-making processes are prerequisites for achievement of environmental protection and sustainable development.

a. Strengthen NGOs and increase their participation.

4. Environmental education programs should be established in school systems as an integral part of general education at all levels, and environmental information and opportunities for environmental training should be provided to the public, ensuring that all people have the knowledge, skills, and values to cooperate in protecting the environment and achieving sustainable development.

5. All persons have the right to effective access to judicial and administrative proceedings, including for redress and remedy, in enforcing their environmental rights. States shall ensure that a person in another State who is adversely affected by transboundary environmental harm has the right of access to administrative and judicial procedures equal to that afforded to its own citizens in cases of domestic environmental law.

6. States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. Each State is liable for significant harm to the environment of other States and to areas beyond the limits of national jurisdiction. States shall cease the activities causing significant harm, restore the damaged environment insofar as possible, and where that is not possible, provide compensation or other remedy for the harm.

7. States shall resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

8. States shall cooperate in the further development of international law and in formulating and strengthening of international rules, standards and recommended practices on issues of common concern for the protection and preservation of the environment and sustainable use of natural resources, taking into account the need for flexible means of implementation based on their respective capabilities.

IX. Environmental Protection

1. States shall take, individually or jointly as appropriate, all measures necessary to prevent, reduce, and control pollution, giving special attention to the disposal in an environmentally safe manner of radioactive, toxic, and other hazardous wastes that cannot be reused or recycled.

2. States shall conduct and encourage scientific research and establish scientific monitoring programs for the collection of environmental information on all aspects of the environment and on human environmental impacts, ensure the dissemination of scientific data and information, and promote scientific cooperation in the fields of environmental conservation and sustainable development, strengthening national capacities.

3. States shall establish specific national standards, including emission, quality, product, and process standards, designed to prevent harm to the environment or to restore or enhance environmental quality.

4. States shall take appropriate measures to prevent transboundary environmental harm. Do not do to others what you would not do to your own citizens.

a. Ensure prior and timely notification and consultation.
b. Set standards, monitor, exchange information.
c. Establish contingency plans for emergencies, including prompt notification.

5. Transboundary natural resources should be used in a reasonable and equitable manner, and States should cooperate with other States in the conservation and restoration of such natural resources.

6. States have an obligation to protect and preserve the atmosphere and to take appropriate measures with regard to activities under their jurisdiction or control to prevent, reduce, or control any atmospheric interference or significant risk thereof, which threatens harm to human health, the community of life, or ecosystems.

7. States shall ensure the conservation and where necessary the regeneration of soils for all living systems by taking effective measures to prevent soil erosion, to combat desertification, to safeguard the processes of organic decomposition and to promote the continuing fertility of soils.

8. States shall take all appropriate measures to maintain and restore the quality of water including atmospheric, marine, ground and surface fresh water, to meet basic human needs and as an essential component of aquatic systems. They shall, in particular, establish standards to safeguard the supply and quality of drinking water and to maintain the capacity of aquatic systems to support life.

9. States shall prohibit the intentional introduction into the environment of alien or modified organisms which are likely to have adverse effects on other organisms or the environment. They shall also take the appropriate measures to prevent accidental introduction or escape of such organisms.

10. Nature shall be secured against degradation caused by warfare or other military activities.

11. Natural and cultural areas, including Antarctica, of outstanding aesthetic, cultural, ecological, scientific, and spiritual significance should be identified, protected, preserved, and restored.

12. Outer space, including the moon and other celestial bodies, is part of the common heritage of humanity, and the exploration and use of outer space should be carried out exclusively for peaceful purposes and so as to equitably benefit and serve the interests of all nations and peoples, including future generations. The exploration and use of outer space should avoid the harmful contamination of the environment in space and on the moon and other celestial bodies and should also avoid causing harm to the environment on Earth through introduction of extraterrestrial matter.

Note: The IUCN/UNEP/WWF report Caring for the Earth (1991) endorses the principle that: "People should treat all creatures decently, and protect them from cruelty, avoidable suffering, and unnecessary killing." However, to date this principle, which is concerned with the treatment of individual sentient beings as distinct from species, has not been included or recommended for inclusion in international law.

SURVEY OF PRINCIPLES

The following principles are listed in web site topic by topic, as below, with links to pages listing all international agreements which touch upon the topic. The SUMMARY (above) represents the author's, Rockefeller's consolidation of these principles.

A Global Partnership
The Problems Facing Humanity
The Unity of the Biosphere and Interdependence Humanity is Part of Nature and the Community of Life The Intrinsic Value of All Life Forms and Respect for Nature A Common Concern of Humanity
Preserve the Health of Natural Systems
Conserve Biodiversity
The Individual's Right to a Healthy Environment A Universal Responsibility to Protect the Environment The Right of All Peoples to Development
Integration of Environment and Development A Policy of Prevention
Environmental Impact Assessment
Precautionary Principle
Establishing Appropriate Demographic Policies
Elimination of Unsustainable Production and Consumption
a. minimize depletion of non-renewable resources
b. ensure renewable resources are used sustainably
c. use all resources with restraint and as efficiently as possible
d. increase energy efficiency
e. promote use of renewable resources to generate energy f. minimize waste: reduce, reuse, recycle
Development and Transfer of Technology
Integration of Environmental and Economic Measures The Polluter Pays
Peace, Development, Environment, and Human Rights are Interdependent Values
Intergenerational Equity and Responsibility A Just and Equitable International Economic Order The Eradication of Poverty
Financial and Technical Assistance for Developing Countries Full and Equal Participation of Women
The Rights and Role of Indigenous Peoples The Rights and Responsibilities of States Democratic Participation
a. the role of NGOs
b. the role of youth
Environmental Education

Equal Access to Administrative and Judicial Procedures Liability and Remedy (Restoration or Compensation) Non-Violent Conflict Resolution
Development of International Environmental Law Prevent, Reduce, Control Pollution
Science and Technology
Environmental Standards and Monitoring
Prevention of Transboundary Harm
Equitable Use of Transboundary Natural Resources Protection of the Atmosphere
Conservation and Regeneration of Soils
Preservation and Restoration of Water Quality Introduction of Alien and Modified Organisms
Prevention of Environmental Degradation Caused by Military Activities Preserving Humanity's Cultural and Natural Heritage Protection of the Environment of Outer Space Humane Treatment of Living Beings

World Scientists' Warning to Humanity
(April 1993)

Introduction Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about.

The Environment The environment is suffering critical stress.

The Atmosphere Stratospheric ozone depletion threatens us with enhanced ultraviolet radiation at the earth's surface, which can be damaging or lethal to many life forms. Air pollution near ground level, and acid precipitation, are already causing wide-spread injury to humans, forests, and crops.

Water Resources Heedless exploitation of depletable ground water supplies endangers food production and other essential human systems. Heavy demands on the world's surface waters have resulted in serious shortages in some 80 countries, containing 40 percent of the world's population. Pollution of rivers, lakes, and ground water further limits the supply.

Oceans Destructive pressure on the oceans is severe, particularly in the coastal regions which produce most of the world's food fish. The total marine catch is now at or above the estimated maximum sustainable yield. Some fisheries have already shown signs of collapse. Rivers carrying heavy burdens of eroded soil into the seas also carry industrial, municipal, agricultural, and livestock waste--some of it toxic.

Soil Loss of soil productivity, which is causing extensive land abandonment, is a widespread by-product of current practices in agriculture and animal husbandry. Since 1945, 11 percent of the earth's vegetated surface has been degraded--an area larger than India and China combined--and per capita food production in many parts of the world is decreasing.

Forests Tropical rain forests, as well as tropical and temperate dry forests, are being destroyed rapidly. At present rates, some critical forest types will be gone in a few years, and most of the tropical rain forest will be gone before the end of the next century. With them will go large numbers of plant and animal species.

Living Species The irreversible loss of species, which by 2100 may reach one-third of all species now living, is especially serious. We are losing the potential they hold for providing medicinal and other benefits, and the contribution that genetic diversity of life forms gives to the robustness of the world's biological systems and to the astonishing beauty of the earth itself.

Much of this damage is irreversible on a scale of centuries, or permanent. Other processes appear to pose additional threats. Increasing levels of gases in the atmosphere from human activities, including carbon dioxide released from fossil fuel burning and from deforestation, may alter climate on a global scale. Predictions of global warming are still uncertain--with projected effects ranging from tolerable to very severe--but the potential risks are very great.

Our massive tampering with the world's interdependent web of life--coupled with the environmental damage inflicted by deforestation, species loss, and climate change--could trigger widespread adverse effects, including unpredictable collapses of critical biological systems whose interactions and dynamics we only imperfectly understand.

Uncertainty over the extent of these effects cannot excuse complacency or delay in facing the threats.

Population The earth is finite. Its ability to absorb wastes and destructive effluent is finite. Its ability to provide food and energy is finite. Its ability to provide for growing numbers of people is finite. And we are fast approaching many of the earth's limits. Current economic practices which damage the environment, in both developed and under-developed nations, cannot be continued without the risk that vital global systems will be damaged beyond repair.

Pressures resulting from unrestrained population growth put demands on the natural world that can overwhelm any efforts to achieve a sustainable future. If we are to halt the destruction of our environment, we must accept limits to that growth. A World Bank estimate indicates that world population will not stabilize at less than 12.4 billion, while the United Nations concludes that the eventual total could reach 14 billion, a near tripling of today's [1993] 5.4 billion. But, even at this moment, one person in five lives in absolute poverty without enough to eat, and one in ten suffers serious malnutrition.

No more than one or a few decades remain before the chance to avert the threats we now confront will be lost and the prospects for humanity immeasurably diminished.

Warning We the undersigned, senior members of the world's scientific community, hereby warn all humanity of what lies ahead. A great change in our stewardship of the earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated.

What We Must Do Five inextricably linked areas must be addressed simultaneously:

1. **We must bring environmentally damaging activities under control to restore and protect the integrity of the earth's systems we depend on.** We must, for example, move away from fossil fuels to more benign, inexhaustible energy sources to cut greenhouse gas emissions and the pollution of our air and water. Priority must be given to the development of energy sources matched to Third World needs--small-scale and relatively easy to implement.

We must halt deforestation, injury to and loss of agricultural land, and the loss of terrestrial and marine plant and animal species.

2. **We must manage resources crucial to human welfare more effectively.** We must give high priority to efficient use of energy, water, and other materials, including expansion of conservation and recycling.

3. **We must stabilize population. This will be possible only if all nations recognize that it requires improved social and economic conditions, and the adoption of effective, voluntary family planning.**

4. **We must reduce and eventually eliminate poverty.**

5. **We must ensure sexual equality, and guarantee women control over their own reproductive decisions.**

The developed nations are the largest polluters in the world today. They must greatly reduce their overconsumption, if we are to reduce pressures on resources and the global environment. The developed nations have the obligation to provide aid and support to developing nations, because only the developed nations have the financial resources and the technical skills for these tasks.

Acting on this recognition is not altruism, but enlightened self-interest: whether industrialized or not, we all have but one lifeboat. No nation can escape from injury when global biological systems are damaged. No nation can escape from conflicts over increasingly scarce resources. In addition, environmental and economic instabilities will cause mass migrations with incalculable consequences for developed and undeveloped nations alike.

Developing nations must realize that environmental damage is one of the gravest threats they face, and that attempts to blunt it will be overwhelmed if their populations go unchecked. The greatest peril is to become trapped in spirals of environmental decline, poverty, and unrest, leading to social, economic, and environmental collapse.

Success in this global endeavor will require a great reduction in violence and war. Resources now devoted to the preparation and conduct of war--amounting to over $1 trillion annually--will be badly needed in the new tasks and should be diverted to the new challenges.

A new ethic is required--a new attitude towards discharging our responsibility for caring for ourselves and for the earth. We must recognize the earth's limited capacity to provide for us. We must recognize its fragility. We must no longer allow it to be ravaged. This ethic must motivate a great movement, convincing reluctant leaders and reluctant governments and reluctant peoples themselves to effect the needed changes.

The scientists issuing this warning hope that our message will reach and affect people everywhere. We need the help of many.

We require the help of the world community of scientists--natural, social, economic, political;

We require the help of the world's business and industrial leaders;

We require the help of the world's religious leaders; and

We require the help of the world's peoples.

We call on all to join us in this task.

The Union of Concerned Scientists sent the World Scientists' Warning for endorsement to all scientists worldwide who have been awarded the Nobel Prize; to members of 10 national science academies in Africa, Canada, Europe, Russia, the United Kingdom, and the United States; and to selected scientists in China, India, Japan, and Latin America.

Over 1670 scientists, including 104 Nobel laureates--a majority of the living recipients of the Prize in the sciences--have signed the Warning so far. These men and women represent 71 countries, including all of the 19 largest economic powers, all of the 12 most populous nations, 12 countries in Africa, 14 in Asia, 19 in Europe, and 12 in Latin America.

The World Charter for Nature
(1980)

The General Assembly of the United Nations

Reaffirming the fundamental purposes of the United Nations, in particular the maintenance of international peace and security, the development of friendly relations among nations and the achievement of international cooperation in solving international problems of an economic, social, cultural, technical, intellectual or humanitarian character.

Aware that:
a) Mankind is a part of nature and life depends on the uninterrupted functioning of natural systems which ensure the supply of energy and nutrients.
b) Civilization is rooted in nature, which has shaped human culture and influenced all artistic and scientific achievement, and living in harmony with nature gives man the best opportunities for the development of his creativity, and for rest and recreation.

Convinced that:
a) Every form of life is unique, warranting respect regardless of its worth to man, and to accord other organisms such recognition man must be guided by a moral code of action.
b) Man can alter nature and exhaust natural resources by his action or its consequences and therefore, must fully recognize the urgency of maintaining the stability and quality of nature and of conserving natural resources.

Persuaded that:
a) Lasting benefits from nature depend upon the maintenance of essential ecological processes and life support systems, and upon the diversity of life forms, which are jeopardized through excessive exploitation and habitat destruction by man.
b) The degradation of natural systems owing to excessive consumption and misuse of natural resources, as well as to failure to establish an appropriate economic order among peoples and among States, leads to the breakdown of the economic, social and political framework of civilization.
c) Competition for scarce resources creates conflicts, whereas the conservation of nature and natural resources contributes to justice and the maintenance of peace.

Reaffirming that man must acquire the knowledge to maintain and enhance his ability to use natural resources in a manner which ensures the preservation of the species and ecosystems for the benefit of present and future generations.

Firmly convinced of the need for appropriate measures, at the national and international, individual and collective, and private and public levels, to protect nature and promote international cooperation in this field.

Adopts, to these ends, the present World Charter for Nature, which proclaims the following principles of conservation by which all human conduct affecting nature is to be guided and judged.

I. GENERAL PRINCIPLES

1. Nature shall be respected and its essential processes shall not be impaired.
2. The genetic viability on the earth shall not be compromised; the population levels of all life forms, wild and domesticated, must be at least sufficient for their survival, and to this end necessary habitats shall be safeguarded.
3. All areas of the earth, both land and sea, shall be subject to these principles of conservation; special protection shall be given to unique areas, to representative samples of all the different types of ecosystems and to the habitats of rare or endangered species.
4. Ecosystems and organisms, as well as the land, marine and atmospheric resources that are utilized by man, shall be managed to achieve and maintain optimum sustainable productivity but

not in such a way as to endanger the integrity of those other ecosystems or species with which they coexist.
5. Nature shall be secured against degradation caused by warfare or other hostile activities.

II. FUNCTIONS

6. In the decision-making process it shall be recognized that man's needs can be met only by ensuring the proper functioning of natural systems and by respecting the principles set forth in the present Charter.
7. In the planning and implementation of social and economic development activities, due account shall be taken of the fact that the conservation of nature is an integral part of those activities.
8. In formulating long-term plans for economic development, population growth and the improvement of standards of living, due account shall be taken of the long-term capacity of natural systems to ensure the subsistence and settlement of the population concerned, recognizing that this capacity may be enhanced through science and technology.
9. The allocation of areas of the earth to various uses shall be planned, and due account shall be taken of the physical constraints, the biological productivity and diversity and the natural beauty of the areas concerned.
10. Natural resources shall not be wasted, but used with a restraint appropriate to the principles set forth in the present Charter, in accordance with the following rules.
   a) Living resources shall not be utilized in excess of their natural capacity for regeneration;
   b) The productivity of soils shall be maintained or enhanced through measures which safeguard their long-term fertility and the process of organic decomposition, and prevent erosion and all other forms of degradation;
   c) Resources, including water, which are not consumed as they are used, shall be reused or recycled;
   d) Non-renewable resources which are consumed as they are used shall be exploited with restraint, taking into account their abundance, the rational possibilities of converting them for consumption, and the compatibility of their exploitation with the functioning of natural systems.
11. Activities which might have an impact on nature shall be controlled, and the best available technologies that minimize significant risks to nature or other adverse effects shall be used. In particular:
   a) Activities which are likely to cause irreversible damage to nature shall be avoided;
   b) Activities which are likely to pose a significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that exposed benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed;
   c) Activities which may disturb nature shall be preceded by assessment of their consequences, and environmental impact studies of development projects shall be conducted sufficiently in advance, and if they are to be undertaken, such activities shall be planned and carried out so as to minimize potential adverse effects;
   d) Agriculture, grazing, forestry and fisheries practices shall be adapted to the natural characteristics and constraints of given areas;
   e) Areas degraded by human activities shall be rehabilitated for purposes in accord with their natural potential and compatible with the well-being of affected populations.
12. Discharge of pollutants into natural systems shall be avoided and:
   a) Where this is not feasible, such pollutants shall be treated at the source, using the best practicable means available;
   b) Special precautions shall be taken to prevent discharge of radioactive or toxic wastes.
13. Measures intended to prevent, control or limit natural disasters, infestations and diseases shall be specifically directed to the causes of these scourges and shall avoid adverse side-effects on nature.

III. IMPLEMENTATION

1. The principles set forth in the present Charter shall be reflected in the law and practice of each State, as well as at the international level.

14. Knowledge of nature shall be broadly disseminated by all possible means, particularly by ecological education as an integral part of general education.

16. All planning shall include, among its essential elements, the formulation of strategies for the conservation of nature, the establishment of inventories of ecosystems and assessments of the effects on nature of proposed policies and activities; all of these elements shall be disclosed to the public by appropriate means in time to permit effective consultation and participation.

17. Funds, programs and administrative structures necessary to achieve the objective of the conservation of nature shall be provided.

18. Constant efforts shall be made to increase knowledge of nature by scientific research and to disseminate such knowledge unimpeded by restriction of any kind.

19. The status of natural processes, ecosystems and species shall be closely monitored to enable early detection of degradation or threat, ensure timely intervention and facilitate the evaluation of conservation policies and methods.

20. Military activities damaging to nature shall be avoided.

21. States and, to the extent they are able, other public authorities, international organizations, individuals, groups and corporations shall:

a) Cooperate in the task of conserving nature through common activities and other relevant actions, including information exchange and consultations;

b) Establish standards for products and manufacturing processes that may have adverse effects on nature, as well as agreed methodologies for assessing these effects;

c) Implement the applicable international legal provision for the conservation of nature and the protection of the environment;

d) Ensure that activities within their jurisdictions or control do not cause damage to the natural systems located within other Sates or in the areas beyond the limits of national jurisdiction;

e) Safeguard and conserve nature in areas beyond national jurisdiction.

22. Taking fully into account the sovereignty of States over their natural resources, each State shall give effect to the provisions of the present Charter through its competent organs and in cooperation with other States.

23. All persons, in accordance with their national legislation, shall have the opportunity to participate, individually or with others, in the formulation of decisions of direct concern to their environment, and shall have access to means of redress when their environment has suffered damage or degradation.

24. Each person has a duty to act in accordance with the provisions of the present Charter; acting individually, in association with others or through participation in the political process, each person shall strive to ensure that the objectives and requirements of the present Charter are met.

Charter of Rights for Sustainable Development
(Dale 1995)

The biosphere is a community to which we belong rather than a commodity belonging to us.

All species have inherent value in the biosphere.

Human beings have stewardship for the quality of water, air and soil of the biosphere.

The entropic throughput of natural resources should reflect their real costs as a factor in production and consumption.

The health and well-being of human and all other species is inseparable from the health and well-being of the biosphere.

Development must be in harmony with the environment.

Any production that is not sustainable cannot be counted as capital.

Optimal allocation of human and natural resources must be in harmony with optimal scale, recognizing the finite limits of the biosphere.

Human activity must not be conducted at the irreversible expense of other species and ecosystems.

Diversity is integral to a sustainable society.

Sustainable development maintains or enhances the integrity of natural capital, thereby contributing to the increased well-being of the human species.

The present generation has an obligation to future generations.

The health of one nation ultimately affects the health of all nations.

Appendix M

Three Differing Myths of Ecological Causation (adapted from Holling 1984)

Three distinct viewpoints, metaphors or myths have dominated perceptions of ecological causation, behaviour and management. The first is an equilibrium-centered view that emphasizes constancy of behaviour over time. The second is a dynamic view that emphasizes the existence of a number of stability regions and the role of instability in the maintenance of resilience of ecological systems. The third is an evolutionary view that highlights organizational change and the surprises generated by such change.

Equilibrium-centered "Nature Constant"

This viewpoint emphasizes not only constancy in time but, as well, spatial homogeneity and linear causation. It leads to equilibrium theories and to empirical measures of constancy that emphasize averaging variability in time and averaging "graininess" in space. It represents a policy world of a benign Nature where trials and mistakes of any scale can be made with recovery assured once the disturbance is removed. Since there are no penalties to size, only benefits to increasing scale, it leads to notions of large and homogeneous economic developments that are seen as affecting other biophysical systems but not being affected by them (Patten 1975; Pimm 1984; Webster et al. 1975).

Multiple equilibria states "Nature Engineered" and "Nature Resilient"

This second viewpoint is a dynamic one that emphasizes the existence of more than one stable state. In one variant, the instability is seen as maintaining the resilience of ecological systems (Holling 1963). It emphasizes variability, spatial heterogeneity and nonlinear causation. This viewpoint emphasizes the qualitative properties of key ecological processes that determine the existence or not of stable regions and of boundaries separating those regions. Continuous behaviour is expected over defined periods that are ended by sharp changes induced by internal time dynamics or by exogenous events, at times large, at times small. The length of the period of continuous behaviour often determines the magnitude of the resulting change and affects policy recommendations. For example, an equilibrium-centered position would argue that warming of climate because of accumulation of greenhouse gases will proceed slowly enough that ecological and social processes will adapt on their own to keep pace. Designed efforts to facilitate adjustment are unnecessary because existing crop types, for example, are likely to be developed to be well adapted to prevailing conditions. This second viewpoint of dynamic, nonlinear nature, however, suggests just the opposite -- that slow changes of the type expected might be so successfully absorbed and ignored that a sharp, discontinuous change becomes inevitable.

Similarly, spatial graininess, small relative to the movement of an organism, is presumed to be averaged-out in an equilibrium-centered view (Levins 1968). The nonlinear viewpoint, however, presents the possibility that small scale events cascade upwards. That has been described for climatic behaviour (Lorenz 1964). And for ecological systems, Steele (1974) notes, as well, that widely ranging animals feed on small-scale spatial variability. If fish could not discover and remain in plankton patches they could not exist.

Organizational change "Nature Evolving"

The final viewpoint is one of evolutionary change. Successful efforts to constrain natural variability lead to self-simplification and fragility. A variety of genetic, competitive and behavioural processes maintain balances in the values of parameters. If the variability changes, the balance shifts. Stability domains shrink, key variables become more homogeneous, e.g. species composition, age structure, spatial distribution. Perturbations that previously could be absorbed no longer can be.

The resulting surprises can be pathological if continuing control requires ever increasing vigilance and cost. But if control is internal and self-regulated - i.e. homeostatic - then the possibility opens for organizational change because the benefits embedded in a larger ecological or social system significantly exceed the costs of local control. Hence evolutionary change requires not only concepts of function but concepts of organization that concern the way elements are connected within subsystems and the way subsystems are embedded in larger ones. Community food webs and trophic relations they represent are an example and have long been a part of ecology.

Those and related developments, connected in turn to hierarchical theory (Simon 1973) on the one hand, and the stability and resilience concepts described earlier, on the other, are starting to provide the framework required for comprehending organizational evolution (Allen and Starr 1982).

Appendix N

Five Frameworks for Sustainable Development

Again, this Appendix is designed to illustrate the wealth of recommendations and different paradigms concerning the sustainable development imperative, from which institutions could draw upon, if they chose to do so.

Ecocentric Ethics
(Merchant 1992, pp. 76-78)

Ecocentric ethics are rooted in a holistic, rather than mechanistic, metaphysics. Holism is based on five assumptions:

1. Everything is connected to everything else. The whole qualifies each part; conversely, a change in one of the parts will change the other parts and the whole. Ecologically, this has been illustrated by the idea that no part of an ecosystem can be removed without altering the dynamics of the cycle. If too many changes occur, an ecosystem collapses. Alternatively, to remove the parts from the environment for study in the laboratory may result in a distorted understanding of the ecological system as a whole.
2. The whole is greater than the sum of the parts. Unlike the concept of identity in which the whole equals the sum of the parts, ecological systems experience synergy: the combined action of separate parts may produce an effect greater than the sum of individual effects. This can be exemplified by the dumping of organic sewage and industrial pollutants into lakes and rivers. The bacterial increases may cause those drinking or swimming in the water to become ill. But if the bottom of the lake is covered with metallic mercury, the overall hazard is more than doubled because the bacteria may also transform the metallic mercury into toxic methyl mercury which becomes concentrated in the food chain.
3. Knowledge is context-dependent. As opposed to the context independence assumption of mechanism, in holism each part at any instant takes its meaning from the whole. For example, in a hologram, produced by directing laser light through a half-silvered mirror, each part of the three-dimensional image contains information about the whole object. There are many-to-one and one-to-many relationships, rather than the point to point correspondences between object and image found in classical optics. Similarly, in perception, objects are integrated patterns. The whole is perceived first with an awareness of hidden aspects, background, and recognition of patterns, as when one views a tree or a house.
4. The primacy of process over parts. As opposed to the closed, isolated equilibrium and near-equilibrium systems studies in classical physics (such as the steam engine), biological and social systems are open. These are steady-state systems in which matter and energy are constantly being exchanged with the surroundings. Living things are dissipative structures, resulting from a continual flow of energy, just as in a vortex in a stream is a structure arising from the continually changing water molecules swirling through it. Ilya Prigogene describes an open, far-from-equilibrium thermodynamics in which new order and organization can arise spontaneously. Nonlinear relationships occur in which small inputs can spontaneously produce large effects.

Continual change and process are not only significant in ecology, but also are fundamental to the new physics. Physicist David Bohm in his book *Wholeness and the Implicate Order* (1980) describes process as originating from an undivided multidimensional wholeness called a holomovement. Within the holomovement is an implicate order that unfolds to become the explicate order of stable, recurring elements observed in the everyday world. The holomovement is life-implicit, the ground of both inanimate matter and of life.

5. The unity of humans and nonhuman nature. As opposed to nature/culture dualism, in holism humans and nature are part of the same organic cosmological system. While theoretical ecologists often focus their research on natural areas removed from human impact, human (or political) ecologists study the mutual interactions between society and non-human nature.

Just as mechanism dovetailed with certain political assumptions, so holism has been seen to imply particular kinds of politics. Holism found favor among philosophers and ecologists during the 1920s. In the 1930s, however, its emphasis on the whole over and above the parts was viewed as being consistent with fascism. This contributed to the relacement of holistic and organismic assumptions in biology by mechanistic modes of description. In the 1960s and 1970s holistic ideas returned, with the blossoming of small-scale back-to-the land communes and households in which decision-making was vested in the consensus of the whole group. Recently the emergence of green politics has given rise to a political movement dedicated to the establishment of an ecologically viable society. Drawing on holistic assumptions, the bioregioanl movement emphasizes living within the resources of the local watershed and developing them to sustain the human and nonhuman community as an ecological whole. Ecocentric ethics also have religious and spiritual components. Deep ecology, nature religions, ecological spirituality, and process philosophy have at their roots an eccentric value system.

Ten Principles for Ecosystem Planning
(Gibson and Tomalty 1995, pp. 3-4)

1: Base planning units on natural boundaries

Conventional planning uses a hierarchy of smaller-to-larger planning units with boundaries that rarely recognize ecological factors. An ecosystem approach replaces the politically oriented hierarchy of planning units with nested units that are established at least in part to respect ecological functions and are assigned natural boundaries.

2: Design with Nature

Traditionally, planners have seen "raw" land as a blank slate ready for human manipulation and use, and have replaced complex ecological processes with engineered, often linear systems. New planning and design approaches based on ecological principles favor more creative solutions based on biological productivity of natural systems, cycling of resources, or reduced need for services through demand management.

3: Consider global and cumulative effects

An ecosystem approach involves a much longer and broader planning horizon than conventional approaches, which have tended to favor short-term and local considerations at the expense of long-term, global concerns. Consideration of off-site, cross-boundary and cumulative effects is included in the ecosystem planning process.

4: Encourage interjurisdictional decision-making

Conventional land use planning is commonly carried out by many separate authorities largely in isolation from each other. The ecosystem approach attempts to overcome jurisdictional fragmentation by encouraging new planning units, agencies and methods that promote interjurisdictional decision making.

5: Ensure consultation and facilitate cooperation and partnering

Unlike conventional planning, in which land use decisions are often made in a technocratic manner after discharging the legal obligation for some perfunctory public involvement, the ecosystem approach actively seeks to involve the widest range of stakeholders effectively and openly in the planning process.

6: Initiate long-term monitoring, feedback and adaptation of plans

Monitoring mechanisms are included in the ecosystem approach to allow communities to assess progress in implementing a plan, to track the response of ecosystem elements when plans are implemented, and to provide a reliable basis for adapting plans to changing conditions. In conventional land use and environmental planning, few resources are expended to assess what happens to ecosystems as plan implementation unfolds.

7: Adopt an interdisciplinary approach to information gathering

Social, demographic, and economic information has been emphasized in traditional planning, with few attempts to assess ecological capacity or to assess how efforts to satisfy socio-economic demands may affect ecological functions. The ecosystem approach implies a greater scale of information gathering, more integration of information and greater cooperation among information providers, both amateur and expert. It also recognizes that information will not eliminate uncertainty in planning and that relevant information may only become available as the plan unfolds.

8: Respect uncertainties and adopt a precautionary approach to growth management, emphasizing collective responsibility for communities and ecosystems

Our knowledge of carry capacities and vulnerabilities of ecosystems, and of the resilience of valued community qualities is necessarily limited. Because of this uncertainty and because there is reason to fear that many ecosystems and communities are already being subjected to unsustainable pressure, planning must aim not just to reduce the specific negative effects of growth, but also to direct regional change in ways that reduce overall stresses and make positive contributions to sustainability.

9: Link ecosystem planning with other aspects of democratic change

Even the most enlightened planning, by itself, is never enough. Advances in planning must be linked to concurrent, broader changes in social attitudes and values that are both democratic and environmentally responsible. Like ecosystem planning, these broader changes require involvement of people in various forms of social learning.

10: Ensure land use planning integrates environmental and economic objectives

Reform of land use planning should be seen as part of the larger task of fully integrating environmental and economic planning so that every economic activity not only maintains the environment, but also helps to restore it.

Wings of the Eagle
(Turtle Talk 1990, pp. 77-84)

From a published interview with Marie Wilson, Spokesperson for the Gitksan Wet'suvet'en Tribal Council from north western British Columbia

When I read about ecofeminism I find that the attitudes towards women and the feelings inside myself are different. It's difficult to explain, but it's as if women are separate. Though I agree with the analysis, the differences must be because of where I come from. In my mind, when I speak about women, I speak about humanity because there is equality in the Gitksan belief: the human is one species broken into two necessary parts, and they are equal. One is impotent without the other.

When I look upon the Western world today, I see this human species broken into a Siamese twin relationship where one wounded partner is being dragged behind the other. There is no co-operation, or pragmatic understanding, which is necessary for the species to be whole.

A North American Indian philosopher has likened the relationship between women and men to the eagle, which soars to unbelievable heights and has tremendous power on two equal wings--one female, one male--carrying the body of life between them. The moment one is fractured or harmed in any way, then that powerful bird is doomed to remain on the earth and cannot reach those heights.

We tend to think: male, female--two species. We are not. We are one. Therefore I am feminine to the largest degree but I cannot bring myself to hurt or blame that male part of me that has come from my body: my sons.

I don't look upon the Earth as my mother. I don't believe the Gitksan ever did. They talked instead of the Power Larger Than Ourselves. They looked upon the land, the sea, the air, the creatures, as created life. Other native peoples did have a vision of the Earth as mother, but I can only speak for Gitksan.

The ground is throbbing with life, the dirt is not really dirt, in a sense, it is full of life. We are a product of the dust of the stars, as others have said. This hand that I hold up is actually a multitude of different organisms living off of the kernel that is my life. There are thousands of different, created things within my body that have nothing to do with the spark that causes our energy to flow. We are the compost of the future. This is exactly the vision that Gitksan have. What do we cherish most in the corner of our gardens? The compost. Where do we put it? Around the tender new life to give it a good start in the new created life it will become. If I had any way of describing myself, that would be the way I would like to be described. I believe this is why the Gitksan believed in reincarnation. They believed that the energy that I create cannot be destroyed--you can change its appearance but the influence remains.

The Gitksan did not have a god in the sky. They has a power larger than themselves which they recognized; they understood the limit of a lifespan and they lived comfortably within that limit. It was this understanding that was fundamental to the covenant created between humans and the land. They knew that the well-being of future generations depended upon caring for all life which the land itself represents. The land is the skin of the Earth--without it, we die. And yet, we're ripping the skin off the Earth without any thought at all, not appreciating that that first inch of soil represents life.

People have asked what is our law. We called them rules because we have no outside control; we used inner control. We didn't have judges or lawyers or supreme courts or anything like that. So the people had to know themselves in order to control themselves. Individuals were under strict self-control and, collectively, this controlled the whole society.

The principles, or rules, were about hunting, about relationships between humans. Self-cleansing before hunting included fasting and meditation, and the hunters removed themselves from the women so that they could go deeply into themselves. In the kill itself there were certain things that had to be done in order to honor that creature: ways of disposing of what was not used, for example, though almost everything was used. Most of what they did was based on common sense which included reason and flexibility, because no two situations are quite the same.

The criteria for judgement were that decisions must be good for the people, not just the decision maker. While people of today dismiss this process as belonging to a primitive time when people were limited, does this mean that today peoples' lives are any less significant? And who will make the choice as to who is expendable and who is not? People in the so-called western world may be materially wealthy, but they are bankrupt in morals. The conditions under which people in less wealthy nations live--including the native peoples in this country--have meant that they are the recipients for decisions made by people who have set themselves up as gods.

You must realize that in my language there is no word for "rights". We have really struggled to find an equivalent in Gitksan-Wet'suwet'en and there is none. The closest we could come to an equivalent was jurisdiction and responsibility. We have obligation and control, and the responsibility that goes with it. "Rights", to us, is a very selfish word.

The Decentralist Design
Kirkpatrick Sale
(Sale 1992, pp. 20-27)

Inasmuch as bioregional designs and institutions take their shape from those principles of nature that enunciate themselves in healthy and fruitful ecosystems, it seems inevitable that a bioregional polity would be essentially based upon the universal phenomenon of decentralism: the devolution of power to small, mainly cooperative, and largely equivalent units.

This is the universal pattern in the natural world, where nothing is more striking than the absence of any centralized control, any inter-species domination, where there are none of the patterns of ruler-and-ruled that are taken as inevitable in human governance. "King of the jungle" is our description of the lion's status, and quite anthropomorphously perverse; the lion (or, better, lioness) is profoundly unaware of this role, and the elephant and rhinoceros (not to mention the tsetse fly) would hardly accede to it. In a biotic community the various sets of animals and plants, no matter how they may run with their own families and clusters, behave smoothly and regularly with each other without the need of any overall system of authority or dominance, any biotic Washington of Wall Street, in fact without any governing organization or superstructure of any kind whatsoever. No one species rules over all-or any-others, not one even makes the attempt, not one even has either instinct or intention in that direction.

What's more, when several subgroups of a single species occupy the same region, there is no attempt to consolidate power in one of them: you never see one colony of crows try to conquer another, one pride of lions try to establish control over all the other lions around. Territoriality, yes: often a subgroup of a species attempts to carve out a niche in the ecosystem for itself and goes to considerable lengths to keep other members of that species (and competing species) away. But that is not governance, not the creation of any central authority, it is merely a familial or communal statement about the carrying capacity of that niche for that species--and, I guess, of who was there first to measure it. And defense, too: there can be quite intense and deadly conflict when one subgroup defends its home--hive or hill, roost or lair--from another, and mammalian families and individuals will often go to great lengths, including aggression at times, to protect females and their young during birth and nesting periods. But these are not battles of conquest, they are not followed by domination of colonization (although some ants will take other ants as prisoners), and they are never caused by one subgroup desiring to establish its rule, its command, over another.

Now there is, of course, one continuous exercise of power between species in the ecosphere: many animals perforce depend on ingesting other animals and a wide range of plants. There is in fact a regular practice we call predation by which certain species live in a quasi-symbiotic relationship of hunter and hunted, eater and eaten, and it is common among all biotic communities and among many species of animals as well as a few plants. But this is not governance, it is not rule or dominance, it is not even aggression of an organized political of military kind. The predatory relationship is certainly one of violence and death (and sustenance and life), certainly one of imbalance and non-reciprocation, but it is never undertaken for anything but food--not for governance, or control, or the establishment of power or sovereignty. An exercise of power it is, but it is still diffused power, almost accidental power. (Moreover, there is always some kind of mutuality at work in predation, even though it is of an unconscious kind and may go quite unappreciated by the prey; one could not really expect the caribou to welcome the attack by the gray wolf pack, though in fact it is a necessary means of controlling the herd's population, and by weaning out the weakest and sickest helps to strengthen the herd's genetic heritage.)

The lessons, then, from the natural world as from human history, seem to be clear enough. Bioregional polities as they evolve would seek the maximum diffusion of power and decentralization of institutions, with nothing done at a level higher than necessary, and all authority flowing upward incrementally from the smallest political unit to the largest.

The primary location of decision-making, therefore, and of political and economic control, should be the community, the more-or-less intimate grouping either at the close-knit village scale of

1,000 people or so, or probably more often at the extended community scale of 5,000 to 10,000 so often found as the fundamental political unit whether formal or informal. Here, where people know one another and the essentials of the environment they share, where at least the most basic information for problem-solving is known or readily available, here is where governance should begin. Decisions made at this level, as countless eons testify, stand at least a fair chance of being correct and a reasonable likelihood of being carried out competently; and even if the choice is misguided or the implementation faulty, the damage to either the society or the ecosphere is likely to be insignificant. This is the sort of government established by preliterate peoples all over the globe, evolving over the years toward a kind of bedrock efficiency in problem-solving simply because if was necessary for survival. In the tribal councils, the folkmotes, the ecclesia, the village assemblies, the town meetings, we find the human institution proven through time to have shown the scope and competence for the most basic kind of self-rule.

As different species live side by side in an ecosystem, so different communities could live side by side in a single city, and cities and towns side by side in a single bioregion, with no more thought of dominance and control than the sparrow gives to the rose, or the bobcat to the wasp. Sharing the same bioregion, they naturally share the same configurations of life, the same social and economic constraints, roughly the same environmental problems and opportunities, and so there is every reason to expect contact and cooperation among them, for some specific tasks, maybe even confederation among them--but of a kind that need not mean diminished power or sovereignty for the community, but rather enlarged horizons of knowledge, of culture, of services, of security.

Of course communities with a bioregional consciousness would find countless occasions that called for regional cooperation--and decision-making--on all sorts of issues from water and waste management, transportation, and food production to upstream pollution seeping into downstream drinking water and urban populations moving into rural farming country. Isolationism and self-sufficiency at a local scale is simply impossible, like fingers trying to be independent of hand and body. Communication and information networks of all kinds would be--would need to be--maintained among the communities of a bioregion, and possibly some kind of political deliberative and decision-making body would eventually seem to be necessary.

The forms for such confederate bodies are myriad and their experiences rich and well-documented, so presumably working out the various systems would not be intractably difficult. A confederation within bioregional limits has the logic, the force, of coherence and commonality; a confederation beyond those limits does not. Any larger political form is not only superfluous, it stands every chance of being downright dangerous, particularly since it is no longer organically grounded in an ecological identity or limited by the constraints of homogenous communities.

If, as the scholars suggest, that goal of government as we have not come to understand it in the 20th century is to provide liberty, equality, efficiency, welfare and security in some reasonable balance, a strong argument can be made that it is the spatial division of power, divided and subdivided again as in bioregional governance, that provides them best. It promotes liberty by diminishing the chances of arbitrary government action and providing more points of access for the citizens, more points of pressure for affected minorities. It enhances equality by assuring more participation by individuals and less concentration of power in a few remote and unresponsive bodies and offices. It increases efficiency and adjusting to new conditions, new demands from the populace it serves. It advances welfare because at the smaller scales it is able to measure people's needs best and to provide for them more quickly, more cheaply, and more accurately. And, because of all that, it actually improves security because unlike the big and bumbling megastates vulnerable to instability and alienation, it fosters the sort of cohesiveness and allegiance that discourages crime and disruption within and discourages aggression and attack from without.

The visioning and formulation of a bioregional polity does nothing in itself, however, to ensure that such a future evolves. But I think there is real and pertinent wisdom in E.F. Schumacher's remark that "only if we know that we have actually descended into infernal regions"--and who would want to deny that is the present condition of the industrial world?--can we summon the courage and imagination needed for a 'turning around,' a metanoia." Once knowing that--knowing what--we may then see "the world in a new light, namely, as a place where the things modern man continuously talks about and always fails to accomplish can actually be done."

That, at any rate, is our only hope. What other choice, really, do we have?

Contrasting Bioregional and the Industrial Scientific Paradigms (Sale 1991, p. 50)

	Bioregional Pardigm	Industrial Scientific Paradigm
Scale	Region Community	State Nation/World
Economy	Conservation Stability Self-sufficiency Cooperation	Exploitation Change/Progress World Economy Competition
Polity	Decentralization Complementarity Diversity	Centralization Hierarchy Uniformity
Society	Symbiosis Evolution Division	Polarization Growth/Violence Monoculture

The Meaning of Confederalism
(Bookchin 1992, pp. 59-66)

Few arguments have been used more effectively to challenge the case for face-to-face participatory democracy than the claim that we live in a "complex society." Modern population centers, we are told, are too large and too concentrated to allow for direct decision-making at a grassroots level. And our economy is too "global," presumably, to unravel the intricacies of production and commerce. In our present transnational, often highly centralized social system, it is better to enhance representation in the state, to increase the efficiency of bureaucratic institutions, we are advised, than to advance utopian "localist" schemes of popular control over political and economic life.

After all, such arguments often run, centralists are all really "localists" in the sense that they believe in "more power to the people"-- or at least, to their representatives. And surely a good representative is always eager to know the wishes of his or her "constituents".

But face-to-face democracy? Forget the dream that in our "complex" modern world we can have any democratic alternative to the nation-state! Many pragmatic people, including socialists, often dismiss arguments for that kind of "localism" as otherworldly--with good-natured condescension at best and outright derision at worst.

On the surface of things, arguments like this for centralized government seem rather compelling. A structure that is "democratic," to be sure, but still largely top-down is assumed as necessary to prevent one locality from afflicting another ecologically. But conventional economic and political arguments against decentralization, ranging from the fate of Perth Amboy's drinking water to our alleged "addiction" to disturbingly, they rest on an unconscious acceptance of the economic status quo.

The assumption that what currently exists must necessarily exist is the acid that corrodes all visionary thinking. Must the present-day extravagant international division of labor necessarily exist in order to satisfy human needs? Or has it been created to provide extravagant profits for multinational corporations? Are we to ignore the ecological consequences of plundering the Third World of its resources, insanely interlocking modern economic life with petroleum-rich areas whose ultimate products include air pollutants and petroleum-derived carcinogens? To ignore the fact that our "global economy" is the result of burgeoning industrial bureaucracies and a competitive grow-or-die market economy is incredibly myopic.

There are sound ecological reasons for achieving a certain measure of self-sustainability. A massive national and international division of labor is extremely wasteful in the literal sense of that term. Not only does an excessive division of labor make for over-organization in the form of huge bureaucracies and tremendous expenditures of resources in transporting materials over great distances, it reduces the possibilities of effectively recycling wastes, avoiding pollution that may have its source in highly concentrated industrial and population centers, and making sound use of local or regional raw materials.

On the other hand, we cannot ignore the fact that relatively self-sustaining communities in which crafts, agriculture, and industries serve definable networks of confederally organized communities enrich the opportunities and stimuli to which individuals are exposed and make for more rounded personalities with a rich sense of selfhood and competence. The Greek ideal of the rounded citizen in a rounded environment--one that reappeared in Charles Fourier's utopian works--was long cherished by the anarchists and socialists of the last century.

We should not, I believe, lose sight of what it means to live an ecological way of life, not merely follow sound ecological practices. The multitude of handbooks that teach us how to conserve, invest, eat, and buy in an "ecologically responsible" manner are a travesty of the more basic need to reflect on what it means to think--yes, to reason--and to live ecologically in the full meaning of the term. Thus, I would hold that to garden organically is more than a good form of husbandry and a good source of nutrients; it is above all a way to place oneself directly in the food web by personally cultivating the very substances one consumes to live, and by returning to one's environment what one elicits from it. Food thus becomes more than a form of material nutriment. The soil one tills, the living things one cultivates and consumes, the compost one prepares--all unite in an ecological continuum to feed the spirit as well as the body, sharpening one's sensitivity to the nonhuman and human world around us. Such monumental changes as the dissolution of the nation state and its substitution with a participatory democracy, then, do not occur in a psychological vacuum where the political structure alone is changed. In the case of Perth Amboy's drinking water, I argued that in a society that was radically veering toward decentralist, participatory democracy, guided by communitarian and ecological principles, it is only reasonable to suppose that people would not choose such as irresponsible social dispensation as would allow the waters of the Hudson to be so polluted. Decentralism, a face-to-face participatory democracy, and a localist emphasis on community values should be viewed as all of one piece. This "one piece" involves not only a new politics but a new political culture that embraces new ways of thinking and feeling, and new human interrelationships, including the ways we experience the natural world. Words like "politics" and "citizenship" would be redefined by the rich meanings they acquired in the past, and enlarged for the present.

It is not very difficult to show--item by item--how the international division of labor can be greatly attenuated by using local and regional resources, implementing ecotechnologies, rescaling human consumption along rational (indeed, healthful) lines, and emphasizing quality production that provides lasting (instead of throwaway) means of life. There is a need, too, for regional integration and to interlink resources among ecocommunities. For decentralized communities are inevitably interdependent upon one another.

Without such holistic cultural and political changes, notions of decentralism that emphasize localist isolation and a degree of self-sufficiency may lead to cultural parochialism and chauvinism. Parochialism can lead to problems that are as serious as a "global" mentality that overlooks the uniqueness of cultures, the peculiarities of ecosystems and ecoregions, and the need for a humanly-scaled community life that makes a participatory democracy possible. We must find a way of sharing the world with other humans and with nonhuman forms of life, a view that is often difficult to attain in overly "self-sufficient" communities.

The concepts of local self-reliance and self-sustainability can be highly misleading. I can certainly agree with David Morris of the Institute for Local Self-Reliance, for example, that if a community can produce the things it needs, it should probably do so. But self-sustaining communities cannot produce all the things they need--unless it is involves a return to a back-breaking way of village life that historically often prematurely aged its men and women with hard work and allowed them very little time for political life beyond the immediate confines of the community itself.

Today we can produce the basic means of life--and a good deal more--in an ecological society that is focused on the production of high-quality useful goods. This is not the same as advocating a king of "collective" capitalism, in which one community functions like a single entrepreneur, with a sense of proprietorship toward its resources. Such a system of cooperatives once again marks the beginnings of a market system of distribution, as cooperatives become entangled in the web of "bourgeois rights"--that is, in contracts and bookkeeping that focus on the exact amounts a community will receive in "exchange" for what it delivers to others. This deterioration occurred among some of the worker-controlled enterprises that functioned like capitalistic enterprises in Barcelona after the workers expropriated them in the Spanish Revolution in 1936.

It is a troubling fact that neither decentralization nor self-sufficiency in itself is necessarily democratic. Plato/s ideal city in the *Republic* was indeed designed to be self-sufficient, but its self-sufficiency was meant to maintain a warrior as well as a philosophical elite. Indeed, its capacity to preserve its self-sufficiency depended upon its ability, like Sparta, to resist the seemingly "corruptive" influence of outside cultures.

Similarly, decentralization in itself provides no assurance that we will have an ecological society. A decentralized society can easily coexist with extremely rigid hierarchies. A striking example is European and Oriental feudalism, a social order in which princely, ducal, and baronial hierarchies were based on highly decentralized communities. With all due respect to Fritz Schumacher, small is not necessarily beautiful.

Nor does it follow that humanly-scaled communities and "appropriate technologies" in themselves constitute guarantees against domineering societies. In fact, for centuries humanity lived in villages and small towns, often with tightly organized social ties and even communistic forms of property. But these provided the material basis for highly despotic imperial states. What these self-sufficient, decentralized communities feared almost as much as the armies that ravaged them were the imperial tax-gatherers that plundered them.

Decentralization, localism, self-sufficiency, and even confederation--each taken singly--do not constitute a guarantee that we will achieve a rational, ecological society. In fact, all of them have at one time or another supported parochial communities, oligarchies, and even despotic regimes. To be sure, without the institutional structures that cluster around our use of these terms and without taking them in combination with each other, we cannot hope to achieve a free, ecologically oriented society.

What often leads to serious misunderstandings among decentralists is their failure in all too many cases to see the need for libertarian forms of confederation--which at least tends to counteract the tendency of decentralized communities to drift toward exclusivity and parochialism.

Confederalism is, above all, a network of administrative councils whose members or delegates are elected from popular face-to-face democratic assemblies in the various villages, towns, and even neighborhoods of large cities. The members of these confederal councils are strictly mandated, recallable, and responsible to the assemblies that choose them for the purpose of coordinating and administering the policies formulated by the assemblies themselves. Their function is thus a purely administrative and practical one, not a policy-making one like the function of representatives in republican systems of government.

A confederalist view involves a clear distinction between policy-making and the coordination and execution of adopted policies. Policy-making is exclusively the right of popular community assemblies based on the practices of participatory democracy. Administration and coordination are the responsibility of confederal councils, which become the means for interlinking villages, towns, neighborhoods, and cities into confederal networks. Power thus flows from the bottom up instead of from the top down and, in confederations, the flow of power from the bottom up diminishes with the scope of the federal council, ranging territorially from localities to regions, and from regions to ever-broader territorial areas.

A crucial element in giving reality to confederalism is the interdependence of communities for an authentic mutualism based on shared resources, produce, and policy-making. If one community is not obliged to count on another or others generally to satisfy important material needs and realize common political goals in such a way that it is interlinked to a greater whole, exclusivity and parochialism are genuine possibilities.

Confederalism is thus a way of perpetuating the interdependence that should exist among communities and regions--indeed, it is a way of democratizing that interdependence without surrounding the principle of local control. While a reasonable measure of self-sufficiency is desirable for every locality and region, confederalism is a means of avoiding local parochialism on the one hand and an extravagant national and global division of labor on the other. In short, it is a way in which a community can retain its identity and roundedness while participating in a sharing way with the larger whole that makes up a balanced ecological society. Confederalism as a principle of social organization reaches its fullest development when the economy itself is confederalized by placing local farms, factories, and other needed enterprises in local municipal hands--that is, when a community, however large or small, begins to manage its own economic resources in an interlinked network with other communities. I would like to think that a confederal ecological society would be a sharing one, one based on the pleasure that is felt in distributing among communities according to their needs, not one in which "cooperative" capitalistic communities mire themselves in the quid pro quo of exchange relationships.

Confederation is thus the ensemble of decentralization, localism, self-sufficiency, interdependence--and more. This "more" is the indispensable moral education and character-building--what the Greeks call *paideia*--that makes for rational, active citizenship in a participatory democracy, unlike the passive constituents and consumers that we have today. In the end, there is no substitute for a conscious reconstruction of our relationship to each other and the natural world.

Confederalism, in effect, must be conceived as a whole: a consciously formed body of interdependencies that unites participatory democracy in municipalities with a scrupulously supervised system of coordination. It involves the dialectical development of independence and de-Confederalism is thus a fluid and ever-developing kind of social metabolism in which the identity of an ecological society is preserved through its differences and by virtue of its potential for ever greater differentiation. It is the point of departure for a new ecosocial history marked by a participatory evolution within society, and between society and the natural world.

Confederalism is a vibrant tradition in the affairs of humanity, one that has a centuries-long history behind it. Confederations for generations tried to countervail a historical tendency nearly as old toward centralization and the creation of the nation-state.

If confederalism and statism are not seen as being in tension with each other--a tension in which the nation-state has used a variety of intermediaries like provincial governments in Canada and state governments in the United States to create the illusion of "local control"--then the concept of confederation loses all meaning. Provincial autonomy in Canada and states' rights in the United States are no more confederal than "soviets" or councils were the medium for popular control that existed in tension with Stalin's totalitarian state.

This same concept of wholeness that applies to the interdependencies between municipalities also applies to the municipality itself. The municipality is the most immediate political arena of the individual, the municipality is the most immediate political arena of the individual, the world that is literally a doorstep beyond the privacy of the family and the intimacy of personal friendships. In that primary political arena, where politics should be conceived in the Hellenic sense of literally managing the polis or community, the individual can be transformed from a mere person into an active citizen, from a private being into a public being. Given this crucial arena that literally renders the citizen a functional being who can participate directly in the future of society, we are dealing with a level of human interaction that is more basic (apart from the family itself) than any level that is expressed in representative forms of governance, where collective power is literally transmuted into power embodied by one or a few individuals. The municipality is thus the most authentic arena of public life, however much it may have been distorted over the course of history.

Unquestionably, there are now cities that are so large that they verge on being quasi-republics in their own right. In such cases, a minimal program might demand that confederations be established within the urban area--namely, among neighborhoods or definable districts--not only among the urban areas themselves. In a very real sense, these highly populated, sprawling, and oversized entities must ultimately be broken down institutionally into authentic municipalities that are scaled to human dimensions and that lend themselves to participatory democracy.

Appendix O

Principles of Sustainability, Sustainable Society Project, University of Waterloo (1989)

Basic Value Principles

1. The continued existence of the natural world is inherently good. This principle affirms the intrinsic value of the natural world and its component life forms, and the ability of the natural world to regenerate itself through its own natural evolutions.

2. Cultural sustainability depends on the ability of a society to claim the loyalty of its people through the propagation of a set of values that are acceptable to the populace and the provision of those socio-political institutions that make the realization of those values possible.

Definition of Sustainability

Sustainability is defined as the persistence over an apparently indefinite future of certain necessary and desired characteristics of the socio-political system and the environment.

Key Characteristics of Sustainability

1. Sustainability is a normative ethical principle. It has both necessary and desirable characteristics. There therefore exists no single version of a sustainable system.

2. Environmental/ecological and social/political sustainability are both required for a sustainable society.

3. We cannot, and don't want to, guarantee persistence of any particular system in perpetuity. We want to preserve the capacity for the system to change. Thus sustainability is never achieved once and for all, but only approached. It is a process, not a state. It will often be easier to identify unsustainability than sustainability.

Principles of Environmental/Ecological Sustainability

1. Life support systems must be protected. This requires decontamination of air, water and soil and reduction in waste flows.

2. Biotic diversity must be protected and enhanced.

3. We must maintain or enhance the productivity of ecosystems through careful management of soils and nutrient cycles, and the development of rehabilitative measures for badly degraded ecosystems.

4. Preventive and adaptive strategies for responding to the threat of global change are needed.

Principles of Socio-Political Sustainability

a) derived from environmental/ecological constraints

1. The physical scale of human activity must be kept below the total carrying capacity of the planetary biosphere.

2. We must recognize the environmental costs of human activities and develop methods to minimize physical throughput per unit of economic activity, reduce noxious emissions, and permit the decontamination and rehabilitation of degraded ecosystems.

3. Equity must be ensured in the transition to a more sustainable society.

4. Environmental concerns need to be incorporated more directly and extensively into the political decision-making process, through such mechanisms as improved environmental assessment, the development of new legal mandates and of an environmental bill of rights.

5. There is a need for increased public involvement in the development, interpretation and implementation of concepts of sustainability.

6. Political activity must be linked more directly to actual environmental experience through decentralization of political power to more environmentally meaningful jurisdictions, and the promotion of greater local and regional self-reliance.

b) derived from socio-political criteria

1. A sustainable society requires an open, accessible political process that has effective decision-making power at the level of government closest to the situation and lives of the people affected by a decision.

2. All persons should have sufficient wealth and security of person for themselves and their families to remove them from the possibility of intimidation, exploitation and coercion of any kind which would inhibit their full participation in political processes.

3. There should exist a minimum level of equality and social justice, including equality of opportunity to realize one's full human potential, recourse to an open and just legal system, freedom from political repression, access to high quality education, effective access to information, and freedom of religion, speech and assembly.

The Platform Principles of the Deep Ecology Movement
(Quoted from Deep Ecology by Bill Devall and George Sessions)

1. The well-being and flourishing of human and nonhuman Life on Earth have value in themselves (synonyms: intrinsic value, inherent value). These values are independent of the usefulness of the nonhuman world for human purposes.

2. Richness and diversity of life forms contribute to the realizations of these values and are also values in themselves.

3. Humans have no right to reduce this richness and diversity except to satisfy vital human needs.

4. The flourishing of human life and cultures is compatible with a substantial decrease of human population. The flourishing of nonhuman life requires such a decrease.

5. Present human interference with the nonhuman world is excessive, and the situation is rapidly worsening.

6. Policies must therefore be changed. These policies affect basic economic, technological, and ideological structures. The resulting state of affairs will be deeply different from the present.

7. The ideological change is mainly that of appreciating life quality (dwelling in situations of inherent value) rather than adhering to an increasingly higher standard of living. There will be profound awareness of the difference between big and great.

8. Those who subscribe to the foregoing points have an obligation to directly or indirectly try to implement the necessary changes.

Bellagio Principles

(Hardy and Zdan 1997)

1. GUIDING VISION AND GOALS

Assessment of progress toward sustainable development should:

- be guided by a clear vision of sustainable development and goals that define that vision

2. HOLISTIC PERSPECTIVE

Assessment of progress toward sustainable development should:

- include review of the whole system as well as its parts
- consider the well-being of social, ecological, and economic subsystems, their state as well as the direction and rate of change of that state, of their component parts, and the interaction between parts
- consider both positive and negative consequences of human activity, in a way that reflects the costs and benefits for human and ecological systems, in monetary and non-monetary terms

3. ESSENTIAL ELEMENTS

Assessment of progress toward sustainable development should:

- consider equity and disparity within the current population and between present and future generations, dealing with such concerns as resource use, over-consumption and poverty, human rights, and access to services, as appropriate

- consider the ecological conditions on which life depends

- consider economic development and other, non-market activities that contribute to human/social well-being

4. ADEQUATE SCOPE

Assessment of progress toward sustainable development should:

- adopt a time horizon long enough to capture both human and ecosystem time scales thus responding to needs of future generations as well as those current to short term decision-making

- define the space of study large enough to include not only local but also long distance impacts on people and ecosystems

- build on historic and current conditions to anticipate future conditions -- where we want to go, where we could go

5. PRACTICAL FOCUS

Assessment of progress toward sustainable development should be based on:

- an explicit set of categories or an organizing framework that links vision and goals to indicators and assessment criteria
- a limited number of key issues for analysis
- a limited number of indicators or indicator combinations to provide a clearer signal of progress
- standardizing measurement wherever possible to permit comparison
- comparing indicator values to targets, reference values, ranges, thresholds, or direction of trends, as appropriate

6. OPENNESS

Assessment of progress toward sustainable development should:

- make the methods and data that are used accessible to all
- make explicit all judgments, assumptions, and uncertainties in data and interpretations

7. EFFECTIVE COMMUNICATION

Assessment of progress toward sustainable development should:

- be designed to address the needs of the audience and set of users
- draw from indicators and other tools that are stimulating and serve to engage decision-makers
- aim, from the outset, for simplicity in structure and use of clear and plain language

8. BROAD PARTICIPATION

Assessment of progress toward sustainable development should:

- obtain broad representation of key grass-roots, professional, technical and social groups, including youth, women, and indigenous people -- to ensure recognition of diverse and changing values
- ensure the participation of decision-makers to secure a firm link to adopted polices and resulting action

9. ONGOING ASSESSMENT

Assessment of progress toward sustainable development should:

- develop a capacity for repeated measurement to determine trends
- be iterative, adaptive, and responsive to change and uncertainty because systems are complex and change frequently
- adjust goals, frameworks, and indicators as new insights are gained
- promote development of collective learning and feedback to decision-making

10. INSTITUTIONAL CAPACITY

Continuity of assessing progress toward sustainable development should be assured by:

- clearly assigning responsibility and providing ongoing support in the decision-making process
- providing institutional capacity for data collection, maintenance, and documentation
- supporting development of local assessment capacity

Appendix P

Recommendations for More Sustainable Economies

Although the dominant socio-economic paradigm (Figure 3.1) has influenced governments for many decades, a wealth of ecological economic literature exists. The following represents only some of the work of leading thinkers in this area. Once again, the dominant socio-economic paradigm has prevented meaningful consideration of these alternative approaches within governments.

Towards Operational Principles for Sustainable Development (adapted from Daly and Cobb 1989 and Daly 1991)

1. The first basic issue is the circular flow of exchange value, as it presently is, or the one-way entropic throughput of matter-energy.

2. The concept of optimal allocation among alternative uses of the total resource flow (throughput) must be clearly distinguished from the concept of optimal scale of total resource flow relative to the environment.

3. Since the market cannot determine an optimal scale anymore than it can find an optimal distribution, the latter requires the addition of ethical criteria; the former requires the further addition of ecological criteria, and both require collective action by the community.

4. Once we accept the question of limiting scale, then we recognize the collective or social nature of the task and the futility of leaving it up to the individualism of the market which can only deal with allocation.

5. Growth should refer to quantitative expansion in the scale of the physical dimensions of the economic system, while development should refer to the qualitative change of a physically nongrowing economic system in dynamic equilibrium with the environment. By this definition the earth is not growing, but it is developing.

6. Sustainable development is defined as development without growth - achievement of a physically steady-state economy that may continue to develop greater capacity to satisfy human wants by increasing the efficiency of resource use, but not by increasing the resource throughput (Daly et al. 1995)

7. Adjustments to the net national product (NPP) are necessary. One adjustment is an expansion of the principle of depreciation to cover consumption of natural capital stocks depleted as a consequence of production. The other is to subtract defensive expenditures made to defend ourselves from the unwanted side effects of growing aggregate production and consumption. The corrected income concept, Hicksian income (HI), is then defined as net national product (NNP) minus both defensive expenditures (DE) and depreciation of natural capital (DNC). Thus, HI=NNP - DE - DNC.

8. Capital should be defined as a stock that yields a flow of goods or service. There are then two categories of capital, natural and humanly created.

9. Strong sustainability would require maintaining both humanly created and natural capital intact separately, on the assumption that they are complements rather than substitutes in most production functions.

10. Since one country's ability to substitute humanly created for natural capital to a high degree depends on some other country's making the opposite (complementary) choice, this complementary balance of humanly created and natural capital should be determined within each nation rather than between nations.

11. Probably the best index of the human economy as a part of the biosphere is the percentage of human appropriation of the total world products of photosynthesis.

12. An immediate imperative is to increase the efficiency of resource use rather than the amount of resources used (development instead of growth).

13. Human welfare depends on the proper functioning of ecosystems.

14. The economic system should be small enough to avoid unmanageable interference with the "ecological invisible hand".

15. Natural capital must remain constant, and natural resources should be priced according to their long run replacement costs.

16. The discount rate must reflect the rate of return on alternative sustainable uses of capital.

17. Human scale should be limited to a level which, if not optimal, is at least within carrying capacity and therefore sustainable.

18. Technological progress should be efficiency-increasing rather than throughput-increasing.

19. Renewable resources, in both their source and sink functions, should be exploited on a profit-maximizing sustained yield basis and in general not driven to extinction. Harvesting rates, therefore, should not exceed regeneration rates; and waste emissions should not exceed the renewable assimilative capacity of the environment.

20. Nonrenewable resources should be exploited, but at a rate equal to the creation of renewable substitutes.

Country Futures Indicators
beyond money-denominated, per capita averaged growth of GNP
(Henderson 1991)

Re-formulated GNP to Correct Errors and Provide More Information

- **PURCHASING POWER PARITY (PPP)** corrects for currency fluctuations
- **INCOME DISTRIBUTION** is the poverty gap widening or narrowing?
- **COMMUNITY BASED ACCOUNTING** to complement current enterprise-basis
- **INFORMAL, HOUSEHOLD SECTOR PRODUCTION** measures all hours worked (paid and unpaid)
- **DEDUCT SOCIAL & ENVIRONMENTAL COSTS** a "net" accounting avoids double counting
- **ACCOUNT FOR DEPLETION OF NON-RENEWABLE RESOURCES** analogous to a capital consumption dealer
- **ENERGY INPUT/GDP RATIO** measures energy efficiency, recycling
- **MILITARY/CIVILIAN BUDGET RATIO** measures effectiveness of governments
- **CAPITAL ASSET ACCOUNT FOR BUILT INFRASTRUCTURE AND PUBLIC RESOURCES**

Complementary Indicators of Progress Toward Society's Goals

- **POPULATION** birth rates, crowding, age distribution
- **EDUCATION** literacy levels, school dropout and repetition rates
- **HEALTH** infant mortality, low birth weight, weight/height/age
- **NUTRITION** e.g. calories per day, protein/carbohydrates ration, etc.
- **BASIC SERVICES** e.g. access to clean water, etc.
- **SHELTER** housing availability/quality, homelessness, etc.
- **CHILD DEVELOPMENT** World Health Organization, UNESCO, etc.
- **POLITICAL PARTICIPATION AND DEMOCRATIC PROCESS** e.g. Amnesty International data, money-influence in elections, electoral participation rates
- **STATUS OF MINORITY AND ETHNIC POPULATIONS AND WOMEN** e.g. Human rights data
- **AIR AND WATER QUALITY AND ENVIRONMENTAL POLLUTION LEVELS**
- **ENVIRONMENTAL RESOURCE DEPLETION** hectares of land, forests lost annually
- **BIODIVERSITY AND SPECIES LOSS**
- **CULTURE, RECREATIONAL RESOURCES**

Ten Recommendations from the *Ecology of Commerce* (Hawken 1994)

Can we imagine a market system that creates, increases, nourishes and enhances life on earth? Can we image competition between businesses that improves living and cultural systems? Can we construct a public-private partnership in the economy that reverses the incentives so that economic success is tantamount to biological success?

1. Any businessperson should create his or her own customized set of standards that will lead to constructive and restorative changes, standards that can be converted into actual day-to-day practices.

2. Sustainable businesses should:
   - (i) replace nationally and internationally produced items with products created locally and regionally;
   - (ii) take responsibility for the effects they have on the natural world;
   - (iii) do not require exotic sources of capital in order to develop and grow;
   - (iv) engage in production processes that are human, worthy, dignified, and intrinsically satisfying;
   - (v) create objects of durability and long-term utility whose ultimate use or disposition will not be harmful to future generations; and
   - (vi) change consumers through education.

3. Political, environmental, and business communities should join in incorporating external costs into the market system.

4. Two types of costs have to be internalized, the actual damage caused by one production system to another system, person, or place as well as the cost to future generations.

5. If adding value is what business is, or should be, all about, then it follows that you can't contribute values unless you have them.

6. Good design seems natural, unaffected, and appeals to common sense. Good design for the commercial system accounts for and appeals to the innate behavioural modes of both governance and commerce.

7. Businesses should literally compete to be more ecological, not only on moral or ethical grounds or because it is the "right thing to do", but because such behaviour squarely aligns with their bottom line. We must design a marketplace that obviates acts of environmental destruction by making them extremely expensive, and rewards restorative acts by bringing them within our means.

8. The most profound act of leadership that could be exerted by business would be to admit that its influence over and manipulation of government is misguided.

9. The introduction of explicitly revenue-neutral green taxes would create the closest thing approximating a truly free market by internalizing many costs now externalized.

10. The whole key to redesigning the economy is to shift incrementally most if not all of the taxes presently derived from "goods" to "bads", from income and payroll taxes to taxes on pollution, environmental degradation, and nonrenewable energy consumption.

Fourteen Recommendations for a Sustainable Society
(Korten 1995)

1. Balance human uses of the environment with the regenerative capacities of the ecosystem.

2. Allocate available natural capital in ways that ensure that all people have the opportunity to fulfill their physical needs adequately and to pursue their full social, cultural, intellectual, and spiritual development.

3. Healthy societies depend on healthy, empowered local communities that build caring relationships among people and help us connect to a particular piece of the living earth with which our lives are intertwined.

4. Whereas our pursuit of material abundance has created material scarcity, our pursuit of life may bring a new sense of social, spiritual, and even material abundance.

5. Economic systems composed of locally rooted, self-reliant economies create in each locality the political, economic, and cultural spaces within which people are able to find their own paths to the future that are consistent with their distinctive aspirations, history, culture, and ecosystems.

6. Healthy societies are environmentally sustainable, so that their rates of renewable resources do not exceed the rates at which the ecosystem is able to regenerate them; rates of consumption or irretrievable disposal of nonrenewable resources do not exceed the rates at which renewable substitutes are developed and phased into use, and, rates of pollution emission into the environment do not exceed the rates of the ecosystem's natural assimilative capacity.

7. Healthy societies provide all their members-present and future-with those things that are essential to a healthy, secure, productive and fulfilling life.

8. Healthy societies nurture the biological and cultural diversity of the planet.

9. In healthy societies, sovereignty resides in civil society and the principle of subsidiarity prevails, which maintains that governance authority and responsibility should be vested in the smallest, most local unit possible.

10. Healthy societies allocate the full costs of resource allocation decisions to those who participate in making them-an essential requirement for efficiency in a self-regulating economic system.

11. Healthy societies recognize that the environmental resources of the planet and the accumulated knowledge of the species are common heritage resources, and it is the right of every person-present and future-to share in their beneficial use. Neither may be rightfully monopolized or used in ways contrary to the broader interest of present and future generations.

12. Sovereignty resides only with people-all people, real people who need fresh air to breathe, clean water to drink, uncontaminated food to eat, and livelihoods that allow them to earn their keep. Neither governments nor corporations can usurp that sovereignty unless we chose to yield it.

13. Corporations have no natural or inalienable rights. The corporation is a public body created by public act through the issuance of a public charter to serve a public purpose. We, the sovereignpeople, have the inalienable right to determine whether the intends public purpose is

being served and to establish legal processes to amend or withdraw a corporate charter at any time we so choose

14. The problem is the system. Incremental changes within individual corporations or political institutions cannot provide an adequate solution. The whole system of institutional power must be transformed.

Ecological Visions for Designing a Sustainable Future
(Stuart B. Hill, 1981)

1. Access to needs - sustainable, equitable access to resources according to unique, individual material, cultural and spiritual needs to optimize human growth, development and fulfillment.

2. Fulfilling work/play - work and play used for fulfillment, human development and psycho-social evolution; diverse careers.

3. Production for use; involves integration, balance, feedback, cooperation.

4. Play is spontaneous, creative, unique, facilitated and free or inexpensive.

5. Measure of sustainable progress - increasing quality of life (awareness, joy, zest, purpose, fulfillment).

6. Designing a sustainable economy - growth and development of "informal economy" (gifts, barter of skills and materials; psychological, social and renewable resource base; supportive of people and environments).

7. Holistic framework - holistic, broad, interactive, heterogenistic.

8. Access to wisdom - internal and external access, integration of outer, objective, formal and environmental knowledge, and inner, subjective intuition and feeling (wisdom).

9. Partnership with nature based on recognition of profound simplicity. . . "wisdom of nature", "natural order" and need for high functional diversity and complex interrelations, and wealth of available, but unused, information, resources, and natural supportive processes, e.g. homeostatic feedback, self-maintaining, self-regulating and optimizing mechanisms, building and maintaining natural order and biological and knowledge, skill and wisdom capital through stepwise change.

10. Awareness of limits and opportunities through sensitivity to limits, potentials and opportunities (physico-chemical, bio-ecological and human).

11. Appropriate planning based on normative, yet innovative, long-term, bio-regional planning.

12. Appropriate action based on recognition of "generic" commonalty of basic processes but need for unique local responses to unique local situations.

13. Sustainable resource base and efficient use of resources through bio-ecological strategies based on solar, renewable and human energy and resources, efficient capture and use of locally available energy; thermodynamically matched to task; low-power; low waste production and supportive of environments and cultures; conserving of human and material resources.

14. Decentralized structures based on decentralization of power and responsibility, local self-reliance and self-determinism (individual, family, group, neighborhood, region, nation), natural bio-regional development; zoning; watershed management and rural resettlement; human need and development division of labour, and minimization of distance (e.g. between people, resources and technologies); localized processes and availability.

15. Appropriate technology based on human-scale, skill promoting technologies that are "information" rich and locally obtained, maintained, and controlled (e.g. small to medium scale

appropriate technologies; machines that are durable, repairable, recyclable or bio-degradable, and have a high life-time efficiency).

A Vision of Sustainable Trade
(Costanza et al. 1995)

Both the North American Free Trade Agreement (NAFTA) and the Uruguay Round of GATT embody a vision of unlimited economic growth in a world where environmental problems are trivial--and most easily solved by more growth. These agreements are rational only within the context of this vision, however. Arguably, this vision is fundamentally flawed because environmental limits are in fact central to humanity's continued survival on the plant.

In an alternative, sustainable vision, trade is one element of a larger exchange among people, communities, and nations that involves goods and services, culture, and information as well as the natural environment. Different countries, of course, have different comparative advantages in goods and services; but they also have differences in culture, social systems, and attitudes toward the environment. These differences cannot simply be homogenized under the banner of free trade. Each community seeks to preserve its identity and maintain its own set of values. Exchanges of culture and information, which one can call symbolic exchanges, are thus as important as exchanges of goods and services.

These symbolic exchange take place at varying levels, depending on the issues involved. For example, discussions of air and water quality in the United States and Mexico may take place at the national level or between border communities specifically affected by these issues. Discussions of global warming necessarily have a world-wide scope. Issues such as the use of recombinant DNA hormones in milk production will be debated at local, regional, and national levels, as well as in international discussions. In discussions of rainforest preservation, numerous perspectives are relevant are relevant, including those of indigenous peoples, development planners, foreign consumers of forest products, minerals, and agricultural products, and domestic and foreign conservationists.

What are the appropriate types of organizations, levels of representation, and channels of communication and harmonization among these different interest groups? Local and national government entities, nongovernment organizations, and international bodies all have a role to play. The best outcome--a consensus among all the affected groups--can only be achieved as a result of dialogue and negotiation in which each recognizes that there is a common good that transcends individual interests. Where consensus cannot be achieved, it is important to respect the rights of local communities.

In many of the issues involving trade and the environment, there is significant uncertainty about the likelihood and severity of environmental impacts. Under such circumstances, maintaining sustainability requires the adoption of the precautionary principle. When the nature and extent of future damage is unknown (as in the case of global warming, the introduction of new chemicals or life forms into the environment, and the extinction of species), this principle calls for erring on the side of precaution; rather than allowing market or trade dynamics to determine events, regulators should act to prevent any potential harm. Simply put, this principle is as follows: If we act as if it matters and it doesn't, then it won't matter, if we act as if it doesn't matter and it does, then it will matter.

The precautionary principle is invoked so frequently in international environmental resolutions that it has come to be seen as a basic normative principle of international environmental law. By itself, however, the principle does not offer complete guidance to policymakers: Although it "implies the commitment of resources now to safeguard against the potentially adverse future outcomes of some decision", it does not indicate how many resources are necessary or which adverse outcomes are most important.

The "size of the stakes" is a primary determinant of how uncertainty is dealt with in the political arenas because high uncertainty or high stakes result in a much more politicized environment. Current methods cannot really deal with either high stakes or high uncertainty, however; these require a new approach, what might be called "post-normal" or "second-order" science. This new science is really just the application of the basic scientific method to a new arena. The scientific method does not imply anything about the precision of the results achieved; it does imply a forum for open and free inquiry without preconceived answers that is aimed at determining the extent of our knowledge or, alternatively, the magnitude of our ignorance.

This view of science implies a new approach to environmental protection, one that acknowledges the existence of uncertainty and provides safeguards against potentially harmful effects, while at the same time stressing low-impact technologies and attempting to broaden understanding. The precautionary principle sets the stage for this approach, but the real challenge is to develop methods of determining the potential costs of uncertainty and to adjust incentives so that the appropriate parties pay these costs. Without this adjustment, the full costs of environmental damage will continue to be left out of the accounting, and the hidden subsidies from society to those who profit from environmental degradation will continue to provide strong incentives to degrade the environment beyond sustainable levels. Only when this step is taken will international trade have the potential to contribute to true global welfare.

Ecoforestry Principles, Implied Practices, and Tools for Monitoring (Global Biodiversity, 1997 (7): 2)

Windhorse Farm has been a managed woodlands for three generations in New Germany, Nova Scotia. Managed according to a very particular set of principles and practices, the original owners did not cut the tallest trees, they protected the riparian zones, and they limited their consumption to what their land offered. Today, Windhorse Farm, reaches in three directions. It is a family farm producing certified organic vegetables, herbs, fruit, and flowers; it is a lumber business that guarantees to its customers that their purchases have not contributed to the destruction of forests; and it is a learning place, teaching the principles and practices of sustainability for forests and forest communities.

Three ecoforestry principles guide their lives and work: an ecological one, an economic one, and a social one. A general practice is linked to each principle, and related specific practices have been developed for this particular woodlot. Results are continually monitored by applying simple tests for success.

Ecological principle

The natural forest is the primary product of ecoforestry; all extracted material is "by-product."

Practice: Manage for natural ecological diversity, not only species diversity but also diversity of age and size of all species, of structure (for example, canopy levels, fallen trees, and stream habitats), and of genetics. First, protect sensitive areas, rare habitats or ecotypes, and landscape connectivity. Next, restore diversity where humans have reduced it. Lastly, harvest timber and non-timber products while causing as little change as possible in the natural diversity and the processes that influence it.

Test: Compare the composition, structure, and function of managed lands with the natural forest appropriate to the site.

Economic principle

Building soil is the only sustainable way to increase the productive capacity of the forest.

Practice: Minimize the removal of trees and other plant material from the site. In order to do this, first reduce the quantity of things you need to buy by substituting on-site resources for imported energy, food, housing, equipment, and so on. Second, to the extent that it is necessary to acquire things from elsewhere, pay for them by selling value-added products; that is, maximize "value-to biomass ratios."

Test: Measure or estimate the amount and distribution of dead wood on the site; compare this with the natural condition.

Social principle

Care for the welfare of all beings.

Practice: Reduce the impact (costs) and spread the wealth (benefits). First, identify your real needs and resist taking more. Second, increase labour intensity where it can be traded off against capital intensity.

Test: Apply full-cost accounting to measure total costs relative to the benefits for the community.

Appendix Q

Case Study: The Collapse of the East Coast Fisheries

I prepared this as background material and sent to my co-researchers on December 24, 1997, in order to ground our research in a concrete case study. One of the co-researchers, Shealag Pope suggested we ground our framework discussions in an actual case study, and she suggested the Atlantic Cod fisheries, given some of the complex interactions between scientists within and outside government, and the apparent conflict with policy advisors.

A brief overview follows on the collapse of the East Coast cod fisheries, taken mainly from key articles and conversations with former bureaucratic colleagues, who prefer to remain anonymous. The summary, therefore, reflects some "facts" that are only known within the bureaucracy.

Context

" . . . in the past century, without much thought about the consequences, we have removed from the sea literally billions of tonnes of living creatures, of wildlife, and added to it billions of tonnes to toxic substances. Fish, whales, shrimps, clams and other living things are widely regarded as commodities not as vital components of the living system upon which we are utterly dependent.

We have a hard time thinking of fish as valuable unless they're dead. True, too, of whales, of trees, and much of the rest of nature in times past. Our accounting system regards these things as free. What is taken is regarded as direct income without affecting costs other than what it has cost to take them out of their natural setting."

Sylvia Earle 's address to IUCN Conference, Montreal, October 1996

From the mid-Sixties to the mid-Eighties our population boomed from 3 to 4 billion. At the same time, the catch of ocean wildlife climbed to a high of nearly 90 million tonnes in 1989. But since then, despite increased effort, new materials, and even better means of finding fish, the annual catch has declined, and for some fisheries the populations have crashed. This has happened in spite of the best efforts to evaluate maximum sustainable yields (MSY).

Paradoxically, commercial fishing already costs much more than is gained by the economies of the nations of the world. At present the annual catch worldwide brings in about US $70 billion and costs $124 billion to land. The difference - $54 billion - is made up in subsidies, in tax dollars paid by others, including those here in Canada who are supporting with millions of dollars the out-of-work cod fishers (Earle 1996).

With respect to the limitations of our knowledge, Ludwig et al. (1993) argue that resource questions about potential yield cannot simply be answered reliably in many, if not most circumstances, because learning about natural resource systems is limited by 1) lack of replicates and controls, 2) lack of randomization in treatments in natural experiments, and 3) changes in underlying systems. This highlights the dichotomy in managing renewable resources. One school suggests that intense detailed scientific research on the biological basis of the systems will provide improved understanding that in turn will lead to better management. An alternative view maintains that the space and time scales of many major systems are such that traditional scientific research will not provide additional useful improved understanding, and that improved design of the monitoring and management systems will provide greater benefits. Holling (1993) and Lee (1993) both argue that there is an important role for scientific research, but not if it is merely "disciplinary, reductionist and detached from people, policies and politics". Holling further maintains that the needed research should be interdisciplinary, nonlinear, focused on the interaction between slow processes and fast ones, and should study cross-scale phenomena.

Scientific assessment blunders have played a major role in the collapse of some potentially sustainable harvested systems. For example, when Canada took over the extended management jurisdiction (200-mile limit) of its east coast fish stocks in the late 1970s, after a period of intense fishing by foreign fleets, scientists overestimated the remaining abundance of cod off Newfoundland by over 200%, leading to a Canadian development of policy that virtually destroyed the cod stock by 1991 (Findlayson 1994; Hutchings and Myers 1994).

Hillborn et al. (1995) state the key lessons learned from the study of sustainable exploitation of fish, wildlife, and forests are:

1. The historical record shows that biological overexploitation is almost universal at some point in the development of a resource, and even when biological overexploitation is avoided, economic overexploitation is the norm.
2. To avoid overexploitation there must be deliberate willingness to forego attempt at maximizing yield;
3. We have the knowledge (from plenty of historical experience with overexploitation) to design management systems that will provide long-term sustainable harvest even when tracking unpredictable environmental changes, but
4. Institutionally, we are generally unable to control exploiters well enough to make the changes necessary to track changing biological productivity and biological understanding. Successful management rests not so much on better science as on the implementation of better institutional arrangements for controlling exploiters and creating incentives for them to behave more wisely.

Background

The fisheries industry has been characterized by boom and bust cycles. As early as 1845 " . . . there is growing evidence that, between 1845 and 1880, increased fishing was having a negative influence on marine resources. As early as the 1840s a significant public demand pressured government to regulate the use of new fishing gears to protect cod stocks. . . With hindsight and late twentieth century awareness, we can now understand that frequent fishery failures and a necessary shift to more intensive technologies, when set beside rapid population increase and large fluctuations in Newfoundland salt cod and seal exports, combine to point to a likely ecological problem (Cadigan 1996). A more recent bust was the herring fishery collapse on the West Coast in the 1960s, which at that time, was used mainly for fertilizer and pet food. Given the increase in demand, decisions were taken to use bigger boats and more efficient technology, resulting in the subsequent crash of the herring fishery. It was re-opened in the 1980s on the basis of a 20 percent spawning biomass. In addition, the market had essentially changed, in that the chief product was herring roe exported to Japan, with the remainder for pet food.

THIS IS ONE OF THE INFORMATION FAILURES, IN THAT WE DO NOT SEEM TO BE ABLE TO LEARN FROM HISTORICAL PRECEDENTS, AND THE SAME MISTAKES ARE PERPETUATED BY MOVING TO SPECIES SUBSTITUTION.

With respect to the East Coast cod fishery, the highest level of Atlantic cod take had occurred before the end of the 1960s, with a slight blip at the beginning of the 1980s (SOE Report 1991). In fact, the stock had been declining since then, and the catch rate, from the time that the 200 mile limit was introduced (1977, effectively placing responsibility for managing eastern Canada's groundfish fisheries with the federal government), rarely made the total allowable catch. Moreover, the graph on the size of mature cod at 7 years of age, from 1976 onwards showed a persistent slope down (SOE Report 1991). Thus, in addition to DOE, Environment Canada scientists would also have been aware of this persistent decline and the ecological ramifications, as would scientists in other government department and fisheries experts in academic institutions.

ANOTHER QUESTION FOR INFORMATION FAILURE, IS WHY ACADEMIC RESEARCHERS AND ORGANIZATIONS SUCH AS THE ROYAL SOCIETY OF CANADA FAIL TO SIGNAL THE PERSISTENT DECLINE BEFORE IT REACHED THRESHOLD LIMITS? THIS INTRODUCES THE QUESTION OF THE ROLE OF SCIENTISTS IN EDUCATING THE PUBLIC AND MAKING PUBLIC TO A FAR WIDER AUDIENCE THEIR RESEARCH, AND IN A WAY THAT IS EASILY UNDERSTOOD BY NON-SCIENTISTS.

It would appear there were many factors involved in the overestimates of the cod fishery. There was a discrepancy in the availability of cod to the inshore and offshore fisheries being reported as early as 1986, with the latter arguing that their catches were low because of overexploitation by offshore trawlers. Ironically, Winter's (cf. in Hutchings et al. (1997) unpublished paper) conclusions were that the size of the cod stock had been overestimated since 1977 and that this overestimation was caused by excessive reliance on abundance indices derived from commercial trawler catch rate data and by violation of assumptions of the multiplicative model used in the assessment procedure. Contrary to the consensus expressed by Lear et al. (1986) which concluded that cold water temperatures were responsible for low inshore catches in 1985, Winters documented a statistically significant negative association between inshore catch and offshore exploitation rate, concluding that "the decline in the inshore catches since 1982 has been due to the increase in the offshore exploitation rate" (Winters 1986).

THUS, THE LINKS BECOME FIRMLY ENTRENCHED BETWEEN TECHNOLOGY, SCALE, EMPLOYMENT AND CONCENTRATION. THUS, THE UNINTENDED EFFECTS OF THE GOVERNMENT POLICIES TO REDUCE THE FLEETS WAS ACTUALLY TO REWARD THOSE MORE EFFICIENT VESSELS (HIGHER TECHNOLOGY), THOSE THAT COULD TAKE A BIGGER CATCH IN A SHORTER PERIOD OF TIME (SCALE), LEADING TO EMPLOYING FEWER PEOPLE, AND UNINTENTIONALLY REINFORCING GREATER CONCENTRATION AT THE LOSS OF COMMUNITY RESILIENCE.

Politically, the Progressive Conservatives were elected in 1982, and John Crosbie held the portfolio of Minister for Fisheries from 1984-1988, for both Fisheries and Minister in the House for the Atlantic Canada Opportunities Agency (ACOA), from 1988-1992. Needless to say, Crosbie, along with other Atlantic Canada players, such as Stuart McGinnes, Dalton Camp, Senator Lowell Murray were a powerful force in the Mulrooney Cabinet. Jobs in Atlantic Canada have always been precious, and it would be safe to say that during this period, due to the over-reliance on fishing as the primary source of employment in many of the Atlantic provinces, jobs took precedence over any ecological concerns and subsequent longer-term social implications, and apparently, over the scientific information that was being presented to Cabinet at this time. Unemployment in Newfoundland was increasingly exacerbated, and there was strong pressure and polarization of the age-old dichotomy of jobs versus the environment. It is no surprise, therefore, that the political decision was taken to maintain the status quo, increasing the size of the vessels and in-shore fish plants (recall the herring collapse of the 60s), and reducing the take by the inland fishers. I have asked the question many times of policy colleagues, whether there was any consideration during this time, of sustainable employment, that is, what nature of employment did we want in the Atlantic Canada? Would it have not been more sustainable to continue to employ more small-scale inland fishers than to make the decision to allow factory-freezer trawlers, and technology that allowed the catch to increase, and mask the fact that the catch was getting smaller and smaller.

GIVEN THE BARRIERS MODEL, IT ILLUSTRATES THE GRIDLOCK BETWEEN INCREASING SCALE, CENTRALIZATION FROM SMALL-SCALE FISHERS TO THE TRAWLERS TO FISH PLANTS, THEREBY FURTHER INCREASING SCALE, LEADING TO INCREASED TECHNOLOGY AND PRIVATIZATION, AND FURTHER DIVERGENCE OF THE THREE IMPERATIVE.

Apparently, when John Crosbie, Minister for Fisheries and Oceans was first making his decisions about the yields for the cod fishery, both his departmental people and scientists told him that the fish would not be there. At that time, the only people with the data was the Department of Fisheries and Oceans. At the same time, the inshore fishers were saying they were not catching the same level of fish to Minister Crosbie. The response from the Minister at that time, was that they did not know what they were talking about, and in 1982, he made the announcement in Newfoundland to increase the size of the ships, met by cheers from the audience. The audience, however, was comprised mainly of the captains of the bigger ships and many employees of the new big plants, and it did not include many in-shore fishers. Many analysts believe the collapse was "doomed with the big ships".

If the above scenario is accurate, this represents an information failure at the individual level, and points to one of the weaknesses of a rigid, hierarchical decision-making system, in which one individual, either because of political leverage, or bureaucratic leverage, can attain so much power that they can influence an entire group or organization, in spite of rational information to the contrary. It may also represent a failure of information between government departments, in that, the lead department channels the information to Cabinet for its decision-making, and if the information is "shaped" by creative writing questioning the accuracy of the data, rather than concentrating on the long-term indicators, then effective decision-making based on the best available information is curtailed. How many bureaucratic and political decision-making points may never be known, protected by the confidentiality provisions surrounding any information that is for the advise and consideration of Cabinet.

ONE HAS TO ASK THE QUESTION, WOULD THE UNCERTAINTIES REGARDING THE STATUS OF NORTHERN COD IN 1986 HAVE BEEN SUMMARILY DISMISSED BY A SCIENTIFIC ESTABLISHMENT WITH NO POLITICAL OR GOVERNMENTAL AFFILIATION?

It is also important to note that science documents have not been developed in close linkage with analyses of policy options. Hence, they do not contain direct assessments of the various options identified by managers and industry. As stated by a former DFO Assistant Deputy Minister for Science "It is the role of the Minister and not of public servants to make policy decisions affecting the fishery" (Morrissey 1993).

At the same time, there were a number of environmental factors affecting the cod. Temperatures have been decreasing on the East Coast for some time, and it appears as if one the effects is that the fish are moving south, and Arctic cod are moving down the coast. There is also continuing debate about the role of other predators, notably seals, although there is evidence that seals will not go after cod when they are hard to find. This debate is still ongoing, and is complicated by the fact that seals eat capelin, and these stocks are also reduced. Thus, it is easy to point the finger away from human exploitation as the primary cause, and to point to environmental determinants and other species as causative factors, a case of denial of the underlying drivers, coupled with an inability to learn from previous collapses, thus, ensuring the inevitability of multiple collapses.

Another overall trend was the reduction in the 1960s of taxonomy and systematics work, and the emphasis on new technologies as a theme that swept right through Canadian universities. This new science and technology push brought into many universities young academics who embraced the new socio-technological paradigm, with a de-emphasis on the fundamentals of biology and its associated monitoring and evaluation of systems.

THIS HIGHLIGHTS ANOTHER INFORMATION FAILURE, THE LACK OF A LONG-TERM STRATEGIC DIRECTION OR A SCIENTIFIC RESEARCH FRAMEWORK, LENDING A BALANCE BETWEEN BASIC AND APPLIED WORK, THEREBY AVOIDING MAJOR GAPS FOR THE FUTURE.

One has also to question the nature of the scientific information itself. As an article in the New Scientist (February 10, 1996) states "Mealy-mouthed advice from scientists is providing politicians with excuses for their failure to save the world's fisheries, according to a report released to the House of Lords. It urges researchers to "give much firmer advice in a form which the political managers could not ignore". Although some analysts have stated there was a failure of the scientific community to adequately convey the aspects of uncertainty, it may well be that the political decision-making level itself does not want to deal with uncertainty, they want definite answers, whereas scientists are very used to couching their information in probabilities.

THUS, THERE MAY HAVE BEEN A FUNDAMENTAL MISMATCH IN INFORMATION NEEDS FOR DECISION-MAKING BETWEEN GOVERNMENT SCIENTISTS, GOVERNMENT POLICY MAKERS AND POLITICIANS.

ONE HAS TO ASK AGAIN, WAS THIS FAILURE WELL KNOWN BY NON-GOVERNMENT SCIENTISTS AND GROUPS SUCH AS THE ROYAL SOCIETY OF CANADA. IF SO, WHY DID THEY NOT RAISE THE ALARM?

As well, there were simply "too many fishers chasing too few fish" (Walters and Maguire 1996). In addition, the government's unemployment insurance scheme may have actually provided an incentive for overfishing as it maintained fishers and their family during the non-fishing seasons, thus supporting more numbers than the ecological base could support. And further compounding the overcapacity problem, was the fact that as the catch became less, the government lowered the weeks necessary to qualify for unemployment insurance, further supporting the fundamental instability of the ultimate crash. Technology was also an important variable. According to Walter and Maguire (1996), trawlers exerted by far the largest share of fishing mortality during the 1980s and 1990s when fisheries were open.

BECAUSE THE SOCIAL IMPERATIVE TOOK PRECEDENCE, MORE FISHERS WERE ARTIFICIALLY MAINTAINED THROUGH THE NON-FISHING SEASON THROUGH UNEMPLOYMENT INSURANCE, THEREBY EMPLOYING MORE WORKERS THAN THE RESOURCE WOULD HAVE NATURALLY SUPPORTED. RATHER THAN MAKING IT A TRADE-OFF BETWEEN JOBS VERSUS THE FISH, IT ARGUES FOR AN INTEGRATIVE FRAMEWORK, IN WHICH THE THREE IMPERATIVES ARE RECONCILED.

It would appear that paradoxically, in spite of our sophisticated information age, natural resource collapses are the result of a fundamental information failure at many levels, in the scientific community, between the scientific and policy communities, and at the bureaucratic and political decision-making levels. It offers quite considerable proof for the diagram I proposed under the Frameworks section on our website, entitled "Barriers Model", that is, the more the ecological, social and economic imperatives diverge, coupled with increasing scale, increasing technology, increasing centralization and increasing privatization, the more inevitable is the total collapse. As well, compartmentalization is a common feature of human activity systems, but it is antithetical to the understanding of ecological systems and processes. Interdisciplinary and institutional barriers constitute a formidable obstacle to the synthesis of ecological understanding and the free flow of intellectual process (Kerr and Ryder 1997). Unless this decision-making gridlock is exposed and new policies developed through this exposure, then any new policies will be developed to maintain the status quo, or change only at the margins.

Post-Script

A recent letter from the Coalition of Gulf Fishermen, whose members are the Federation of Gulf Nova Scotia Groundfishermen, along with the P.E.I. Fishermen's Association and the New Brunswick-based Maritime Fishermen's Union and the Alliance des pecheurs du Quebec, to Fisheries Minister David Anderson gives vent to their anger. "Nothing will effectively capture the fury we have at the blatant disregard you are demonstrating towards the vast majority of 'professional' fishermen in the Southern Gulf of St. Lawrence." Their specific complaints include allowing draggers and trawlers into the cod fishery; possibly allowing a winter cod fishery in the Gulf; requiring very expensive observers on fishing boats to ensure regulations are respected, and allowing mesh size requirements in trawler nets that invite the capture of small, commercially useless fish. The letter states that the use of trawlers became popular when governments decided to treat the fishery as an industry. "But all over the world, we see it is folly to industrialize the catching of fish. The trawlers and draggers are too efficient" (Ottawa Citizen, July 13, 1998).

Appendix R

Systems Perspectives: Definitions taken from Principia Cybernetica Web

http://www.pespmc1.vub.ac.be/SYSTHEOR.html

System 1) a set of variables selected by an observer (Ashby 1960). Usually three distinctions are made: 1. An observed object. 2. A perception of an observed object. This will be different for different observers. 3. A model or representation of a perceived object. A single observer can construct more than one model or representation of a single object. Some people assume that 1. and 2. are the same. This assumption can lead to difficulties in communication. Usually the term "system" is used to refer to either 1. or 2. "Model" usually refers to 3. Ashby used the terms machine, system, and model in that order for the three distinctions. 2) a set or arrangement of entities so related or connected so as to form a unity or organic whole. 3) any definable set of components (Maturana and Varela 1979)

Systems Theory the transdisciplinary study of the abstract organization of phenomena, independent of their substance, type, or spatial or temporal scale of existence. It investigates both the principles common to all complex entities, and the models which can be used to describe them.

Systems theory was proposed in the 1940s by Ludwig von Bertalanffy, and furthered by Ross Ashby (1956). von Bertalanffy was both reacting against reductionism and attempting to revive the unity of science. He emphasized that real systems are open to, and interact with, their environments, and they can acquire qualitatively new properties through emergence, resulting in continual evolution. Rather than reducing an entity (e.g., the human body) to the properties of its parts or elements (e.g., organs or cells), systems theory focuses on the arrangement of and relations between the parts which connect them into a whole (cf. holism). This particular organization determines a system, which is independent of the concrete substance of the elements (e.g. particles, cells, transistors, people, etc). Thus, the same concepts and principles of organization underlie the different disciplines, providing a basis for their unification. Systems concepts include: a system-environment boundary, input, output, process, state, hierarchy, goal-directedness, and information.

Systems theory is closely connected to cybernetics and also to system dynamics, which models changes in a network of coupled variable (e.g., the "world dynamics" models of Jay Forrester of MIT and the Club of Rome). Related ideas are found in the emerging sciences of complexity, studying self-organization and heterogeneous networks of interacting actors, and associated domains such as far-from-equilibrium thermodynamics, chaotic dynamics, artificial life, artificial intelligence, neural networks, and computer modeling and simulation.

Whole Without recognition of its parts a whole is an essentially structureless and unanalyzable unity. If its parts are independent or randomly sampled by an observer, a whole has no outstanding quality other than that of being an observer's aggregate. If a whole is qualitatively different from a mere aggregate of its parts, the difference lies in its structure or organization. Thus any whole may be understood as, described in terms of, and considered equal to a structure or an organization of component parts. In some cases the properties of its parts may be ignored without appreciable loss of understanding a whole, particularly when parts are numerous, simple and the same as in the objects of computer sciences, macro-economics, and quantum physics, all of which heavily rely on mathematics and their constructions. When parts are few, complex, different, and tenuously related, as in a marriage, the properties or the parts figure more prominently in the understanding of a whole and can not be ignored in favor of such wholes' organization.

Holism the process of focusing attention directly on the whole and its characteristics as a whole, without any recourse to consideration of its parts. A philosophical position claiming (a) that wholes cannot be taken apart and (b) that every apparent whole can be understood only in the context of the larger whole containing it. This belief is epitomized in the statement that "a whole is more than the sum of its parts".

Construct A hypothetical variable or system which does not purport to accurately represent or model given observations but has a heuristic or interpretative value concerning them. Constructs may be (1) ideal types as the economist's concept of rational behavior. Rationality can be formalized, leads to elaborate constructions for the motivation of economic behavior and stimulates empirical inquiries into why actual behavior does not conform to it. Constructs may be (2) hypothetical entities, processes or mechanisms which would explain the connections between observed causes and consequences if those entities, processes or mechanisms existed. Human memory is such a construct. It bridges the gap between past experiences and current behavior. Psychological examples are the Freudian id, ego, and super ego for which physiological evidence is principally unavailable. Finally, constructs may be (3) the algorithms capable of generating a certain process or product without evidence for whether this rather than another computational procedure is followed in practice.

Context The material that surrounds an item which helps define its meaning. The environment of something that establishes or classifies its meaning (Arbib). In linguistics, the environment of a particular word may disambiguate the meaning of that word, e.g., the word "play" in "I saw a play" vs. "I play the guitar". In communication, the context of a situation, which is comprised of all non-linguistic constraints including the social roles ascribed to the communicators, specifies the information of what is said relative to what could be said. In biology, the environment of an organism is similarly crucial in understanding what the organism does. In cybernetics, text and context are two complementary components (the subsystems) of one system each of which could be considered to constitute or define the other's meaning.

Cybernetics (1) The science of communication and control in animal and machine. (2) Perhaps because the field is still young, there are many definitions of cybernetics. Norbert Wiener, a mathematician, engineer and social philosopher, coined the word "cybernetics" from the Greek word meaning steersman. He defined it as the science of communication and control in the animal and the machine. Ampere, before him, wanted cybernetics to be the science of government. For philosopher Warren McCulloch, cybernetics was an experimental epistemology concerned with the communication within an observer and between the observer and his environment. Stafford Beer, a management consultant, defined cybernetics as the science of effective organization. Anthropologist Gregory Bateson noted that whereas previous sciences dealt with matter and energy, the new science of cybernetics focuses on form and pattern. (3) A way of looking at things and a language for expressing what one sees.

Whereas general systems theory is committed to holism on the one side and to an effort to generalize structural, behavioral and developmental features of living organisms on the other side, cybernetics is committed to an epistemological perspective that views material wholes as analyzable without loss, in terms of a set of components plus their organization. Organization accounts for how the components of such a system interact with one another, and how this interaction determines and changes its structure. It explains the difference between parts and wholes and is described without reference to their material forms. The disinterest of cybernetics in material applications separates it from all sciences that designate their empirical domain by subject matters.

In cybernetics, theories tend to rest on 4 basic pillars: variety, circularity, process and observation. Variety is fundamental to information, communication and control theories and emphasizes multiplicity, alternatives, differences, choices, networks, and intelligence rather than force and singular necessity. Circularity occurs in its earliest theories of circular causation or feedback, later in theories of recursion and of iteration in computing and now involving self-reference in cognitive organization and in autonomous systems of production. Traditional sciences have shied away from if not exorcised the use of circular explanations. It is this circular form which enables cybernetics to explain systems from within, making no recourse to higher principles or a priori purposes, expressing no preferences for hierarchy. Nearly all cybernetic theories involve process and change, from its notion of information, as the difference between two states of uncertainty, to theories of adaptation, evolution and growth processes. A special feature of cybernetics is that it explains such processes in terms of the organization of the system manifesting it, e.g., the circular causality of feedback loops is taken to account for processes of regulation and a system's effort to maintain an equilibrium or to reach a goal.

Cybernetics and systems science tends to focus on complex systems such as organisms, ecologies, minds, societies, and machines. Cybernetics and systems science regards these systems as complex, multi-dimensional networks of information systems. Some of the characteristics of cybernetic systems are:

Complexity Cybernetic systems are complex structures, with many heterogeneous interacting components.

Mutuality These many components interact in parallel, cooperatively, and in real time, creating multiple simultaneous interactions among subsystems.

Complementarity These many simultaneous modes of interaction lead to subsystems which participate in multiple processes and structures, yielding any single dimension of description incomplete, and requiring multiple complementary, irreducible levels of analysis.

Evolvability Cybernetic systems tend to evolve and grow in an opportunitistic manner, rather than be designed and planned in an optimal manner.

Constructivity Cybernetic systems are constructive, in that as they tend to increase in size and complexity, they become historically bound to previous states while simultaneously developing new traits.

Reflexivity Cybernetic systems are rich in internal and external feedback, both positive and negative. Ultimately, they can enter into the ultimate feedback of reflexive self-application, in which their components are operated on simultaneously from complementary perspectives, for example as entities and processes. Such situations may result in the reflexive phenomena of self-reference, self-modeling, self-production, and self-reproduction.

Development The process of a systematic unfolding of a system's structure. In biology, all molecular processes that underlie the growth to maturity of an organism. In psychology, the correlation between age and the capacity to engage in certain behaviors, particularly in children. In the economics of underdeveloped countries, the concept is politically controversial because it implies progressive structural changes from primitive to advanced forms and because this current use of the term by Western economists may serve technological imperialism. Nevertheless, the unfolding and growth of structures to their natural limits and their eventual replacement by new forms is observable, particularly in society, and without the need to refer to life-cycles or to assume progress, making development an important adjunct of the cybernetic concern with organization.

Feedback information about the results of a process which is used to change the process itself. Negative feedback reduces the error or deviation from a goal state. Positive feedback increases the deviation from an initial state (Umpleby). A circular causal process in which a system's output is returned to its input, possibly involving other systems in the loop. Negative feedback or deviation reducing feedback decreases the input and is inherently stabilizing, e.g., the governor of a steam engine. Positive feedback or deviation amplifying feedback increases the input and is inherently destablizing, explosive or vicious, e.g., the growth of a city when more people create new opportunities which in turn attract more people to live there.

Hierarchy (1) A form of organization resembling a pyramid. Each level is subordinate to the one above it. (2) An organization whose components are arranged in levels from a top level down to a bottom level. (3) A partially-ordered structure of entities in which every entity but one is successor to at least one other entity; and every entity except the basic entities is a predecessor to at least one other entity . (4) Narrowly, a group arranged in order of rank or class; we interpret it to denote a rank arrangement in which the nature of function at each higher level becomes more broadly embracing than at the lower level.

Lag Metaphorically, trailing behind. In development, some variables may change faster than others and if they are dependent on each other these temporal differences, called lag, can cause structural stress within a system, e.g., in modern society, institutional developments tend to lag behind changes in technology causing many social problems from alienations to social inequalities and conflicts. In cybernetics, lag refers to the time for information to pass through one complete feedback loop. Lag makes regulation difficult.

Synergy derives from the holist conviction that the whole is more than the sum of its parts and, because the energy in a whole cannot exceed the sum of the energies invested in each of its parts, that there must therefore be some quantity with respect to which the whole differs from the mere aggregate. This quantity is called synergy.

Appendix S

Environmental Fields
(summarized from Emery and Trist 1965; 1972)

Emery and Trist introduced the concept of what they defined as environmental fields in 1965, and what post-modernists now refer to as the importance of context(s). I contend that sustainable development issues fall mainly into highly turbulent fields, which has direct relevance to any framework for governance.

Changes beginning in the 1960s (and continuing today) in the levels of uncertainty and complexity in the contextual as well as the task environment of organizations led the Tavistock Institute to characterize these environmental properties into four ideal types: the placid random, the placid clustered, the disturbed-reactive and the turbulent environment. The difficulties are so great that maladaptive defenses are massively in evidence. These manifest themselves as different but related forms of splitting: superficiality in which depth connection is lost; segmentation in which parts pursue their ends without reference to the whole; and dissociation in which people and groups cease to respond to each other.

It is not enough, however, to just characterize an environment and postulate minimum survival characteristics for systems in those environments. Environment and system do not just co-exist side by side. They interact to the point of mutual inter-penetration. Some aspects of the environment become 'internalized' by the system and some aspects of the system become externalized to become features of the environment.

Placid, randomized environment

The simplest type of environmental texture is that in which goals and noxiants ('goods' and 'bads') are relatively unchanging in themselves and randomly distributed. The economist's classical market corresponds to this type. A critical property of organizational response under random conditions is just the simple tactic of attempting to do one's best on a purely local basis (Schutzenberger 1954, p. 101). The best tactic, moreover, can be learnt only by trial and error and only for a particular class of local environmental variances (Ashby, 1960, p. 197). While organizations under these conditions can exist adaptively as single and indeed quite small units, this becomes progressively more difficult under the other types.

Placid, clustered environment

More complicated, but still a placid environment is one that can be characterized in terms of clustering: goals and noxiants are not randomly distributed but hang together in certain ways. It corresponds to Ashby's 'serial system' and to the economist's 'imperfect competition'. The clustering enables some parts to take on roles as signs of other parts or become means-objects with respect to approaching or avoiding. Survival, however, becomes precarious if an organization attempts to deal tactically with each environmental variance as it occurs. The new feature of organizational response to this kind of environment is the emergence of strategy as distinct from tactics. Survival becomes critically inked with what an organization knows of its environment.

Disturbed, reactive environment

The existence of a number of similar organizations now becomes the dominant characteristic of the environmental field. Each organization does not simply have to take account of the others when they meet at random, but has also to consider that what it knows can also be known by the others.

The part of the environment to which it wishes to move itself in the long run is also the part to which the others seek to move. Knowing this, each will wish to improve its own chances by hindering the others, and each will know that the others must not only wish to do otherwise, but also know that each knows this. It may be compared with Ashby's ultra-stable system or the economist's oligopolic market. Operations, in addition to strategy becomes important, one has now not only to make sequential choices, but to choose actions that will draw off the other organizations. It now become necessary to define the organizational objective in terms not so much of location as of capacity or power to move more or less at will, to strategies of absorption and parasitism.

Turbulent fields

In these, dynamic processes, which create significant variances for the component organization, arise from the field itself. The dynamic properties arise not simply from the interaction of the component organizations, but also from the field itself. The 'ground' is in motion. Three trends contribute to the emergence of these dynamic field forces:

1. The growth to meet type 3 conditions of organizations, and linked sets of organizations, so large that their actions are both persistent and strong enough to produce autochthonous processes in the environment. An analogous effect would be that of a company of soldiers marching in step over a bridge.
2. The deepening interdependence between the economic and the other facets of the society. This means that economic organizations are increasingly enmeshed in legislation and public regulation.
3. The increasing reliance on research and development to achieve the capacity to meet competitive challenge. This leads to a situation in which a change gradient is continuously present in the environmental field.

For organizations, these trends mean a gross increase in their area of relevant uncertainty. What become precarious under type 4 conditions is how organizational stability can be achieved. What is critical is the emergence of values that have overriding significance for all members of the field. Social values are regarded as coping mechanisms that make it possible to deal with persisting areas of relevant uncertainty. Values are, therefore, not strategies or tactics; as Lewin (1936) has pointed out, they have the conceptual character of 'power fields' and act as injunctions. Such a transformation, however, can be regressive, or constructively adaptive, according to how far the emergent values adequately represent the new environmental requirements.

Trist and Emery argue that the values critical to meeting this new environmental context are unlikely to establish themselves unless a new social context emerges through the spread of trans-bureaucratic organizations and the creation of a common 'ground' through the influence of the media of the information technology. The chances of this being accomplished depend on the appropriateness of the interdependent systems of personal values, organizational forms and modes of political regulation which emerge. A new culture of politics is required which, assisted b y 'adaptive planning', is able to regulate complex, rapidly but unevenly changing societies--based on the acceptance of pluralism and the surrender of power.