1 Preamble: the world we are in

From the first members of the human species wandering the African savannahs down to the present day we have witnessed ice ages, extreme events of various kinds and a plethora of cultural, political, historical and other changes. We live in a changing world and it was ever thus. But things are different now. At the beginning of the third millennium we have a nexus of social, economic, technological and environmental trends the like of which has not been seen before.[1] Population growth has brought us to the point where we are the dominant species on this planet, and there is growing evidence of our power to modify the global climate. Human activity is affecting the global biosphere in ever more complex ways as a result of technological development, resource use and industrialisation.[2] We are approaching global constraints on our activities, particularly through our modification of global cycles of energy, water and nutrients.[3] We have unprecedented global connectivity through advanced transportation and telecommunications systems. Our social organisation and our economic activity have grown to the point where we have reached and exploited just about every corner of the globe; so we are now the dominant planetary engineers.[4] In the past thirty years there has therefore been a sea change in our relationship with the planet on which we live. We now have a much more complex and recursive relationship with ourselves and with nature.[5] This is why I am going to argue in this book that there is something different this time, something that is a challenge we have not faced before. I am going to argue that there is something qualitatively and quantitatively different this time around in terms of the nature of the constraints, the speed of change, and the magnitude and complexity of the tasks we face if we are to achieve sustainability.

The process of growth and development has not been linear or constant. There are both long-term trends in the human condition – population growth, cultural development, global exploration, resource use – and cyclical patterns of political and economic activity and technological development. Human societies have grown and collapsed many times in human history. The causes of growth and collapse are many and varied, arising from a mix of intrinsic and extrinsic factors.[6] Certainly some of the past collapses have been associated with regional environmental degradation, such as deforestation and soil erosion; in other cases social and economic factors have dominated. The one long-term trend that is focusing minds at the present time is population growth, resource use and the possibility of global change. For the first time in human history we have the potential to make irreparable changes to the entire global fabric, including atmospheric chemistry, global nutrient cycles, climate, water distributions, land use and biodiversity. The constraints are now global as well as regional. These

are the long-term drivers on our present thinking about the human condition, which may lead to the predicted 'singularity': when technology and environmental change reach a new convergence point.[7]

Technology development, innovation and resource use has also led to a number of quasi-cyclical changes in economic activity during the past two centuries in particular. Each cycle has been characterised by upswings and downswings in economic activity and intensity of energy and resource use.[8] Although their existence is debated, some claim to have identified approximately fifty-year cycles of economic activity over the past two centuries (known after their first proponent as Kondratiev cycles). Technology development has characterised each cyclical period of economic growth and resource use in the modern era: steam engines, canals, iron production from coke and spinning machines in the (so-called) first Kondratiev cycle beginning around 1789; coal, railways, steamships and the telegraph in the second cycle beginning around 1846; oil, automobiles, electricity, wireless and telephones in the third cycle beginning around 1897; jet aircraft, television, nuclear power and computers in the fourth cycle beginning around 1950. At the turn of the new millennium, it is said, we are about to enter a new cycle – the fifth Kondratiev cycle – which is likely to be dominated by such technologies as wireless communications, multi-media, nanotechnology, genetic engineering, superconductors and what has been called 'friction-free' capitalism.[9] We are progressively 'dematerialising' the global economy.

Whatever the precise timing and nature of these cyclical patterns in economic and sociocultural activity, when taken together with the longer term drivers of human population growth, resource use and ever greater global mobility and connectivity, we are brought to a particularly significant turning point in the present 'fifth' cycle. Table 1.1 summarises some of the current global driving forces.

A more sustainable future for all inhabitants of the global biosphere requires some reconciliation and consilience between these various time varying drivers and responses. The key products of technological advances in the late modern era – loss of biodiversity, resource depletion, impacts on global elemental cycles (including climate change), rising energy prices, global flows of financial capital and global markets for products and services (including culture, sport and the arts) – are affecting all our lives. Convergence between many of these driving forces means that we live in a time of rapidly increasing complexity and of changing relationships, both between ourselves as individuals and as global communities and between ourselves and the natural world.[10]

Before we go any further there is an important point that must be made. Despite the evident problems at the turning of the millennium, and although there is need for concern over the speed and magnitude of change and for some urgency, we should not lose sight of the successes of the modern era. Life really was 'nasty, brutish and short' for all before the advent of Western humanist

Table 1.1 *Major global trends and key issues at the beginning of the twenty-first century*

Population growth
De-ruralisation and urbanisation
Poverty, inequality, terrorism
AIDS, avian influenza
Water supply, sanitation
Changes to global biogeochemical cycles[11]
Climate change, greenhouse effect
Environmental degradation, loss of ecosystem structure
Habitat destruction, land use change
Loss of biodiversity
ICT revolution
Computers, digital communications, World Wide Web, Internet
Mobile telephony
Multi-media convergence
Biotechnology, biosensors
Nanotechnology
Advanced materials
Globalisation of finance
Commoditisation
Growth of China and India
Growth of externalities
Increasing cost of some resources (oil)
Complex systems
Postmodernism (or Radical Modernism)
Feminism

ideals. Even those who believe that it has all gone wrong and that we now live in the wreck of Western culture accept that progress has been made.[12] Now this, of course, is very much a Western view. There are far too many people in this world for whom the evident successes of the modern era do not apply, and the very fact that we have a set of United Nations Millennium Development Goals[13] is an indication that there is still much to be done. There are still too many for whom clean water, sanitation and sewers, health care and reliable supplies of varied foodstuffs are but a dream. Poverty and inequality remain and must be addressed, and progress in the West has been bought at a price. Sustainability and development are therefore closely interconnected and, because of the close link between global sustainability, development, health and freedom, following Amartya Sen I would definitely add public health and freedom to the list of achievements and issues to be worried over.[14]

A global network society is emerging, shrinking time and space through information and communications technologies (ICT), mobile telephony and the World Wide Web.[15] The ICT revolution is daily bringing us added information about the ever-increasing human impact on the planetary biosphere, the dramatic reductions in biodiversity and the threat of global climate change. In his book *The Condition of Postmodernity* David Harvey argued that the West experienced a sea change in its experience of time and space after about 1972, into a condition of postmodernity.[16] (Looking back on it we can now see that the 1970s were a time of change in many aspects of the human experience. As well as the many social changes during that decade – including changing attitudes to Nature and the environment – Tim Flannery has shown that the global climate went through a 'magic gate' in 1976 as global warming suddenly became more evident.[17] Certainly, as I shall show later, the climate over parts of Australia changed suddenly in that year.) Without including the climate changes, Mark Taylor[18] insists that this present period of change is as far reaching as that at the end of the eighteenth century: the industrial revolution. The ICT revolution brings us information and builds knowledge with unprecedented speed and scope, and widens the reach of our intellect. Web search engines and television news bring us access to global databases and snapshots of global events; time and space are telescoped and fragmented.[19] Some have argued that an 'extended mind' is emerging.[20] Certainly there is now a need to pay heed to the social construction of mind and the possibilities for creative collaboration that the new technologies bring.

As knowledge is being made more accessible there is a trend throughout the Western world towards subsidiarity: the pushing down of decision making to local and regional communities and the shrinking of central governments.[21] In his book *The Third Way* Anthony Giddens[22] discussed the challenges and ethical issues of governing in this new and fragmented world and identified the trend towards 'double democratisation' – of managing both globalisation and subsidiarity simultaneously – as a major issue to be dealt with. Subsidiarity empowers local and regional decision making; as I shall argue, this is both a good and a bad thing, but in the end sustainability will depend on the decisions that individuals take in the context of signals received and incentives provided by markets, government policies and global interactions. In 1988 Joseph Tainter wrote about the historical and archaeological evidence for relationships between growing complexity and the collapse of past attempts at constructing sustainable human societies. The present experiment has global implications. One of the major themes of this book will be the importance of regional, local and individual actions and the ways in which, when played out in the context of global and national information sources, signals and incentives of various kinds, they determine larger-scale outcomes. In ecological, social and economic systems

and their interactions, the microscopic really does determine the macroscopic outcome. Globalisation and subsidiarity place huge demands on individuals and communities for increased capacity and improved decision making under conditions of complexity and uncertainty.[23] The 'extended mind' is both a boon and a challenge. This increased complexity of information flows and relationships from the individual to the global is a feature of the modern world which adds to the level of personal challenge. So the present ICT revolution has also led to conceptual and philosophical advances in the area of complexity and complex systems that in many ways bring greater realism to our world view. In this respect the idea of the 'extended mind' has real merit.

Relationships, collaboration, trust and social capital[24] are the keys to success in this more complex technological, social, environmental and economic context in which we all live. The social science literature has much to offer us in this regard. This book could in many ways be seen to be an extended commentary on Anthony Giddens' *The Consequences of Modernity* in the context of the management of natural resources and the environment at the turn of the new millennium.[25] Perhaps nowhere else has the effect of these changes struck so hard. The influences of new scientific knowledge revealing complex interactions and fundamental limitations on human actions, and the setting of that knowledge in new economic, technological, institutional and social contexts, have totally changed the way we view, value and manage our biosphere and natural resources. Science is being dragged into the world of Realpolitik, an uncomfortable position in which it finds itself ill suited to exist. This is a world of uncertainty and risk, quite different from the controlled world of disciplinary science.[26] Nevertheless this is inevitable and things are changing. The position I take here is one of attempting to understand and explain complexity and systems behaviour; one in which I lean towards John Ralston Saul's view on the importance of the apprehension of context and of shared responsibility.[27] Anyone who studies systems in all their complexity can do no other.

Ideas are changing rapidly, long-standing theories and practices are being overturned and new concepts are being developed. The rising concern over sustainability merely adds to the complexity of our daily decision making, so we can add environmental factors to the social and economic challenges of the 'third way'. Above all we must now accept and cope with greatly increased complexity at all levels in our lives: individually, at the level of the community, nationally and even internationally. Do we as individuals and institutions have the capacity to adapt and grow under these circumstances? For that to happen there must be a strong dialogue between institutions and individuals in a changing world. This isn't rocket science – it is much harder. If it was easy we would have figured it out by now.

The importance of context

So to understand how we got here requires an appreciation of social, economic and intellectual history because the present situation has deep historical and contingent roots. The landscape in which we live in the West (and in other parts of the world) very much reflects a period of faith in progress and expansionism: the Modern Era. Safety, security, wealth and improved public health were the drivers of behaviour and values. Acts of enclosure changed medieval landscapes to 'modern' ones and brought with them the beginnings of pollution and urban blight. 'Where there's muck there's brass' was a common saying in Northern England during the heyday of its industrial period of mills and densely populated cities. What the industrial revolution created was a modern (Western) semiotics of place, a set of signs and symbols that were used to define and describe our sense of place in the landscape. These semiotics were different depending on class, social standing and place of birth, but taken together there was a defined set of values and sensibilities that described the modern world. The modern era similarly produced a set of urban semiotics. Modern cities are now almost the same everywhere in terms of architectural design and scale, and the expansion of modern techniques of water storage and supply, power generation and distribution, manufacturing and transport, have led to an urban modernist sameness all across the globe.

Each new technological advance and each new cycle of development brought periods of change; the early cycles of the industrial revolution were no exception. It was also a period of great social and economic change.[28] There are parallels with the present time. Not only was the relation between science, nature and society then changing rapidly (as it is now), but basic concepts and understanding were undergoing major revisions also. The cultural and philosophical context – what we (think) we know, how we know it and what we do with the knowledge we have – has changed over time in quite fundamental ways. Whereas the limitation during the industrial revolution was social capital (natural resources were thought to be unlimited) there is now a dawning recognition of both a need for a dramatic increase in social capital and capacity to deal with complexity as well as an urgent need to live within a limited stock of natural capital and resources.

There are huge sunk costs which limit our present options and determine our course of action.[29] Even if we determined to change our ways and become sustainable overnight (even assuming we knew how to do this) it would take generations to achieve the result. We are hedged about by many words that begin with the letter C: culture, community, capitals, constraints, complexity, connectivity and context. Cultural persistence is an important aspect of the *longue durée*, which determines many aspects of human life.[30] So, first: culture, community values and semiotics do not change rapidly. Ideas, concepts and values are

slow to change; we are much more dependent on the past than many realise.[31] Second, there are many forms of capital that must be considered in addition to the more familiar financial capital. To be sustainable we must balance the growth of financial capital with various other forms of infrastructure development (physical capital) and the critical forms of human, social and knowledge capital. All this is set in the context of the use, conservation and restoration of environmental or natural capital. Third, there are biophysical limitations and **constraints**. Changes in global and regional stocks and flows of key elements and materials are now evident, and response times may be long. Drastic cuts in global carbon dioxide emissions do not lead to immediate reductions in the concentration of carbon dioxide in the atmosphere because of the long residence times involved. Water supply is limited by climate and rainfall; building new dams does increase the total water supply for human use, but only by the amount harvested from catchments and diverted from their component ecosystems. The huge investments required and the lifetimes of our built infrastructure (from home appliances such as toilets and washing machines, to major power, water and transport infrastructure) mean that we cannot re-engineer our built environments overnight. Fourth, the interactions between the biosphere and the human-dominated world (sometimes called the anthroposphere) are highly complex and variable in space and time and form a set of complex interacting and adaptive systems. Complex adaptive systems are those in which the nature of the networks of interactions (the connectivity) between components changes with time and is influenced by the context so that novel properties emerge, which are not predictable from the behaviour of individual components. Some of our 'limits to growth' arise from these recursive interactions.

The concepts of place and human dominion

A series of concepts and values that were centred on progress, domination and exploitation of the natural world and a requirement for certainty and security were appropriate when the world seemed limitless. In a time when nature seemed boundless and threatening the plan was to have dominion over the natural world, to subdue it and exploit it for human benefit. We made particular efforts to provide safety and security for the human race in the face of risk and variability. We were highly successful in this aim.

Since the earliest times *Homo sapiens* has been a curious animal; curious firstly in the sense of our constant search for knowledge about the world and for explanation and security[32] and secondly in the sense of quirky or peculiar. Our success as a species is a direct result of the success of the first strategy, but we have never succeeded in freeing ourselves from our evolutionary history. The evolutionary context is crucial. As bipedal primates of a particular longevity and stature we see the world in particular ways and have a predilection for

some types of explanation over others. What we know, how we know it and what we do with the knowledge gained is always set in a biological, cultural and historical context, which changes slowly with time.[33] We always were very good at particular time and space scales, particularly those that suited a two-metre-high primate that lives for decades, but very bad at perceiving others, particularly the very small and the very fast and the very large and slow. We have numerous curious (peculiarly human) perceptions of cause and effect, some of which we shall have cause to (re-)consider as this book unfolds.

Now that we have come to dominate the planet it is high time to understand what is going on at those inconveniently large and small scales and to lift the level of the debate around critical issues such as the need for security and the impact of our actions around the globe. Throughout the world there is land clearing, habitat fragmentation, loss of biodiversity, degradation of water quality and increasing dryland salinity.[34] Make no mistake, there is urgent need for action on all fronts: more than 40% of the original planetary biomes have now been destroyed and the figure will reach more than 60% by 2050.[35] Over half of the world's major river systems are seriously affected by fragmentation and flow regulation resulting from the construction of dams.[36]

It would be disingenuous of me to deny that there is debate about the so-called 'litany' of environmental degradation. There are many who deny that the world is going to hell in a hand basket, and many who insist that statements such as those I have made above about climate change and biodiversity loss are merely the usual 'litany' and just more 'green' scaremongering.[37] There is a debate about whether 'business as usual' is not just as good a strategy as wholesale sackcloth and ashes. There should be such a debate. Part of the basis of the debate comes from political, religious and social attitudes to the natural environment: we do not all share the same values or land ethics, and no-one is free from bias. Part of the debate also comes from some fundamental issues around the nature of the evidence and varying interpretations and appreciations of uncertainty, risk and even outright indeterminism. Nothing is as simple as it might seem and the world is indeed very complex. We hold vigorous debates and take firm positions in opposition while standing on quicksand. This endangers all involved. There is, however, in my view, a growing sense of realism abroad.

The human population is now about 6 billion; even so there is no question that the lot of the average global inhabitant has improved dramatically in the past hundred years, even the past fifty. Wealth and longevity are increasing, major diseases have been defeated and the average calorific intake per capita is increasing. This is, however, being bought at a cost to the natural environment and limitations are now beginning to be seen in the depletion of natural capital.[38] This is the direct result of the 'Davy Crockett syndrome': once the world was large enough that it was always possible to find another forest to cut down, or another fish population to exploit in even deeper water. If we could

not live off the interest from the local natural capital we could always live off the capital itself and then move somewhere else and repeat the trick. Now we have explored and altered the far corners of the Earth and over-fished the ocean depths,[39] dominion must give way to negotiation and constraint. Debates rage about how much has been lost, the nature of the evidence for loss and ways of knowing. The stories we tell ourselves are changing. Science, which once meant power and wealth for the few and human domination of the biosphere by many, has become a matter of contention. The nuclear bomb, Chernobyl, radioactivity, genetically modified organisms (GMOs), bovine spongiform encephalopathy (BSE) and 'foot and mouth' disease have all called into question the relationships between knowing things, and using and distributing the information.

There is a growing consensus that the next fifty years or so are going to be critical. If we can manage the transition we have a chance to set a new course to a more ethical and sustainable future. E. O. Wilson has written of a potential 'bottleneck' in the next fifty years[40] and raises the important issue of how much progress we can make in areas such as climate change and biodiversity conservation before we irreversibly damage the fabric of the planet. Certainly there is growing evidence that we are reaching the physical limits of the globe in terms of population growth, our use of available land for agriculture[41] and impacts on global elemental cycles.[42] We face the problems of maintaining food production through intensive production practices.[43]

The importance of ethics and systems thinking

I am not going to address the global 'litany' at length here. The arguments have been well made by others, especially and most elegantly by E. O. Wilson. What I wish to address here is the question: 'Can we grasp the complexity of it all and, if so, what do we do about it?' Given the fundamental nature of the problem – the destruction of the biosphere and its ecosystem services together with the huge changes going on in human societies and cultures driven by globalisation and technological change – the precautionary principle would suggest that even if the epistemology is flawed, the data are partial and the evidence is shaky, we should pay attention to the little we know and do whatever is possible to mitigate the situation even if we fundamentally disagree about the means and the ends. The only ethical course of action is, as John Ralston Saul writes,[44] based on 'a sense of the other and of inclusive responsibility'. We know enough to act. Ethics is about uncertainty, doubt, system thinking and balancing difficult choices. It is about confronting the evidence.

Over the past two or three decades, as there has been an increasing appreciation of the importance of good environmental management, and as western societies have become more open and the ICT revolution has made information much more widely available there has been a growing debate between the

worlds of science, industry, government and the community around environmental ethics and environmental issues and their management. During this period new knowledge has been gained, ideas have changed (sometimes quite fundamentally) and there have been huge changes in government and social institutions and policies. We are all on a recursive journey together: we are literally 'making it up as we go along'. This is not easy and there are no optimal solutions. This is an adaptive process requiring feedback from all parts of the system. Yes, there will be surprises. This is why it is so important that when we act we constantly reflect on what we know and what we are doing about it and where it is all going.

As we reach the physical limits of the global biosphere the values we place on things are changing and must change further. A new environmental ethic is required, one that is less instrumental and more embracing. Traditionally there has tended to be a schism between those who take an anthropocentric view (that the world is there for us to use) and those who take the non-anthropocentric view (those who value nature in its own right). Orthodox anthropocentrism dictates that non-human value is instrumental to human needs and interests. In contrast, non-anthropocentrics take an objectivist view and value nature intrinsically; some may consider the source of value in non-human nature to be independent of human consciousness.[45] What is required is a more complex and systems view of ethics which finds a middle ground between the instrumentalist and objectivist views. Norton,[46] for example, proposes an alternative and more complex theory of value – a universal Earth ethic – which values processes and dynamics as well as entities and takes an adaptive management view of changing system properties. For sustainable development to occur, choices about values will remain within the human sphere but we should no longer regard human preferences as the only criterion of moral significance. 'Humans and the planet have entwined destinies'[47] and this will be increasingly true in many and complex ways as we move forward. There are calls for an Earth ethic beyond the land ethic of Aldo Leopold.[48] The science of ecology is being drawn into the web.[49] Ecologists are becoming more socially and culturally aware and engaged[50] and the 'very doing' of ecology is becoming more ethical.[51] Some scientists are beginning to see themselves more as agents in relationships with society and less as observers.

One important consequence of this is that conservation biology is becoming less of a movement that is concerned with the setting aside of the world's 'last great places' and more one that is concerned about the 'rest of nature': the place in which we all live.[52] What we have attempted to do in the past is the geographical separation of the instrumentalist and the objectivist views – setting areas of natural capital aside from our focus on physical and financial capital growth on the rest of the planet – but this policy, the conservation of biodiversity through the establishment of special reserves, simply is not working.