Introduction

This article explores aspects of sustainability and the importance of sustainable development, including the place of the crucially important resource of fresh water and of freshwater ecosystems. It examines the treatment of natural resources by the economic system that underpins global business, outlines some progress towards more sustainable approaches to business, and recommends steps to re-establish science as the driver of wise policies that contribute to sustainable development.

Sustainability

Sustainability comes naturally to the human species. Sustainability is, in essence, the capacity for indefinite continuance - as simple as that - and the complex biosphere of planet earth has adapted sustainable methods of cycling its closed system of matter through net inputs of solar energy (Odum 1982, 1983; Holmberg et al. 1996). The human species, as indeed all other species, evolved as an interdependent part of this greater sustainable whole. The problem arises from our relative sophistication, and our consequent capacity to manipulate nature to our own advantage.

Society ultimately depends entirely upon nature's goods - food, clean water, timber, etc. - and the irreplaceable life-support services that purify the air we breathe, provide the soil fertility that sustains our crops, cleanse water through complex biogeochemical cycles, etc. Nature's complex and adaptive ecosystems, through the processes that they perform, collectively make life possible on this planet. As one of the prerequisites of life, fresh water is one of these critical goods. Freshwater ecosystems also provide many of the fundamental biogeochemical services upon which the continuity of life depends.

This integral relationship of human and nature not only makes life possible, it also underpins the totality of economic activities. Wealth generation,
ultimately, is merely the manipulation of ecosystem goods and services through human labour and creativity.

**Sustainable development**

It is precisely because we are so remote from living within the supportive capacity of these ecosystem goods and services that development towards a state of sustainability - sustainable development - is today's most urgent priority.

As population grows and natural resources diminish, the "environmental headroom" in which people live and businesses operate is constantly decreasing. Fresh waters provide a graphic illustration of this squeeze in "headroom"; indeed, water is likely to be the primary limitation to human development world-wide in the coming millennium (Ramsar 1996; UNEP 1999). This has concentrated thinking about sustainable development, and the probability of inherent economic and social unsustainability if the environmental and ethical implications of business are overlooked.

Pressures arising from contracting environmental headroom manifest themselves through diverse routes, many of which may at first consideration have no relationship with environmental or ethical impacts at all. However, resource scarcities and rising costs, more stringent regulation, adverse public reputation even to the extent of boycotting of products, difficulties in securing capital, and so on, can all arise from unsustainable performance and investment priorities (Everard 1999). Collectively, the various regulations, reputation issues, planning controls and other factors constitute a "license to operate" granted by society to businesses and other enterprises. This "license" is increasingly tightening due to declining headroom.

Many words have been written about sustainable development being a matter of integrating economic with social and ecological development. In reality, all three factors are indivisibly linked into one internally interdependent whole. By continuing uncontrollably to mine them without regard for their values, we deplete the very ecosystem goods and services that sustain life and wealth-creation activities. By hurting nature, we hurt both ourselves and our economic interests.

**Economy**

Capitalist business is perhaps the most pervasive of belief systems across the world. Like it or not, it nevertheless remains the medium through which the bulk of human society has chosen to trade, and to interact with itself and allocate the ecosystem goods and services that it exploits. The economic systems that underpin business are then crucial determinants of the sustainable exploitation of natural and human resources. Furthermore, with increasing trends of internationalisation and growing corporate power, the capacity of
business to act positively or negatively towards sustainability now exceeds that of national governments (Hawken 1993). Today, for example, 52 of the world’s 100 leading economies are companies, not countries (WWF 1998). Furthermore, since 1997, private sector sources of investment have outstripped governmental sources of developing world investment and, in particular, private finance now dwarfs state aid mediated via the World Bank (Esty 1998).

Business then, and the economics that drive business decisions, must be the primary target for seeking to accelerate progress towards the sustainable use of aquatic and other natural resources.

*The GDP paradigm*

At the start of the Industrial Revolution, natural resources were abundant compared to the limiting resources of labour and technologies for creating wealth (Jackson 1996). This state of affairs set the economic paradigms of development that remain in effect today, wherein natural resources are undervalued but labour is taxed heavily. However, the underlying balance of limiting factors has changed diametrically in the intervening two centuries due to rising population, increasing automation, and declining natural diversity and productivity. Today, for example, the fishing industry worldwide is limited by fish, no longer by the availability of boats or fishermen, or the sophistication of fishing technology (Kurlansky 1997; Hawken et al. 1999; Lovins et al. 1999).

The preoccupation of market economies with Gross Domestic Product (GDP) is a legacy of this concentration on finance as the only capital of any importance to business. One of the more stark illustrations of the inappropriateness of this anachronistic approach is that even those manifestly unsustainable parts of the market economy - for example, increasing expenditure on pollution abatement and clean-up, medical treatment for damage to health, or the downstream costs of crime - count as positive on the GDP balance sheet. Yet GDP remains the primary indicator of economic progress worldwide, including the primary duty of the UK’s new Regional Development Agencies (DoE(NI) 1998) and one of the targets for overseas aid to developing countries.

The Industrial Revolution paradigm, under which we still labour, treats the fundamental and irreplaceable ecosystems goods and services as largely inexhaustible, unlimited and "for free". The sad state of present thinking is that ecosystems feature predominantly *downstream* in the process, once all of the decisions have been taken on a largely financial basis. This downstream "greening" approach treats protection of nature, through activities associated with minimising or mitigating pollution "end of pipe", as a net cost (Everard 1999).
The value and devaluation of natural capital

Globally, Costanza et al. (1997) conservatively estimated the value of all of the earth’s ecosystem services to be at least $33 trillion a year - close to the world’s total GDP. Various authors have questioned the accuracy or the relevance of this figure. Nevertheless, the theoretical value remains staggering in both its magnitude (even if it were, for the sake of argument, out by as much as three orders of magnitude) as well as the degree to which it is wholly overlooked in the balance sheets of companies and nations who depend completely upon these ecosystem services.

The reality is that, as natural resources supporting business are systematically depleted, however remotely along supply chains, these businesses will tend towards non-sustainability. Although business non-sustainability might be perceived as resulting from a variety of causes - including, for example, more stringent regulations, adverse public opinion, declining stocks and increasing costs of natural resources or components manufactured from them, or difficulty in securing loans - these are generally merely downstream effects resulting from the upstream unsustainable exploitation of natural and human resources (Everard 1998, 1999).

Declining capital and the need for restoration

The net result of these unsustainable uses of natural capital - the goods and services provided by nature - is that they are in decline, and their capacities for renewal are breaking down. There is hard evidence that the very life support systems that provide the goods and services upon which society depends - economically, socially, spiritually and as a matter of survival - are unravelling. A third of the natural world was lost between 1970 and 1995, and the process is continuing at an increasing rate (WWF 1998). At the same time, a sixth of the world’s land area is now degraded as a result of overgrazing and poor farming practices whilst 25% of global fish stocks are currently depleted and a further 44% are being fished at their biological limit (UNDP 1998). In a gloomy but well-substantiated assessment, UNEP (1999) note that it is already too late to halt much of the world’s environmental damage, including shortages of clean water, deforestation, topsoil loss, oceanic eutrophication, loss of coral reefs, climate change and urban air quality.

Fresh water is likely to be the principal limiting factor to human development world-wide in the future (Ramsar 1996), and indeed is already so not merely in large tracts of the developing world but also in many developed nations including parts of the UK, Australia and the USA (Everard 1999). UNEP (1999) estimates that the present shortage of clean water will get steadily worse, and that two out of three people will not have access to adequate clean drinking water within 25 years. The implications for aquatic ecosystems are both clear and alarming.
On the social account, we also find that the "poverty gap" has widened and, today, half of the world's population has a combined income less than the assets of the richest 225 people (UNDP 1998). Figures far less scary than these prompted international initiatives towards sustainable development in the early 1980s. Now, well over a decade since publication of the Brundtland Report (WCED 1987), there has never been a greater urgency for action.

Trends identified by UNEP (1999) are blamed largely upon over-consumption, mainly by developed nations. The report concludes that time is running out to make progress towards a more sustainable way of life. It is clear from today's depleted levels of natural resources, and the trends of continuing loss, that the realisation of a fully sustainable future can only be conceived if we not only halt the destructive trends but also begin the process of restoration of ecosystem goods and services.

**Natural capital and economic interest**

Environmental sustainability can be defined as the "maintenance of natural capital" (Goodland & Daly 1996). More generically, sustainability also embraces the maintenance of human and economic capitals.

**Putting a price on natural capital**

Lovins et al. (1999) and Hawken et al. (1999) believe that the answer to reorienting economics towards sustainability lies in an approach they term as *natural capitalism*, wherein the capital upon which industry, agriculture and society trade are fully recognised. These capitals of course, in ecological terms, include the natural goods and services provided by ecosystems. This approach is not dissimilar to research into *full-cost accounting* (as summarised, for example, by Howes 1998), the aim of which is to bring into the economic decision-making process natural assets, in addition to merely financial considerations. To ecosystem values we should also bring into consideration the human capital that is equally fundamental to wealth-creation and social stability. The Forum for the Future's *four capitals* model - including *natural*, *human*, *social* and *manufactured* capitals, as applied by Wessex Water (1998) - seeks to provide indices of sustainability for corporate reporting. (Note: Forum for the Future have subsequently developed this into *five capitals* model by dividing manufactured capital into *manufactured* and *financial* capitals, as applied by Wessex Water 1999). Research initiatives such as the Index of Sustainable Economic Welfare (ISEW) have sought to discount environmental and social damage from the economic account in the form of a wider "quality of life" index (Daly & Cobb 1989).

These strands of research offer great theoretical possibilities. They are important in directing thinking *upstream*, in process terms, towards the
ecosystem goods and services that constitute the sources of human and economic welfare.

Return on capital

If a successful business can be defined by its return on financial capital it must, in a future sustainable world, be measured by its return on the natural and human capitals that it exploits in addition to the financial capital. No business that depletes the financial capital upon which it runs can be sustained in the longer term; in a world of diminishing natural and human capitals, the same principle of unsustainability will also apply. Innovative technologies and ways of doing business are therefore required not merely to reduce resource utilisation, but to address the fact that future business will be defined by the capacity of companies to meet the needs of a growing human population sharing diminishing natural resources. UNEP (1999) points to over-consumption as the root of much of the impending environmental and human crisis.

Initial progress towards more sustainable resource use of natural goods and services can be made through resource efficiency, for example through "Factor 4" (Weizsäcker et al. 1997) and similar approaches. However, resource efficiency - doing more with less - is only one step towards truly sustainable resource use, albeit a very important first step. Alternative technologies will be required to realise industry "holy grails" such as zero emissions, closed loop manufacture, etc., which are described in other publications. In the field of water resources, closed water-cycle manufacture - as pioneered in paper mills and fish farms in some countries - may become the norm as scarce water resources are allocated to other human needs.

Restoration of natural capital

In the light of the current vast overspend of natural capital, allied with the pressure of a growing global population, the process of sustainable development will not merely have to stabilise consumption of primary resources. It will be necessary to move beyond stasis into restoration of natural capital. For example, the need not just to prioritise the protection of wetlands, but to go beyond into their restoration, has been identified as a key aspect of "Wise Use" by the Ramsar Convention (Ramsar 1996). The same need is true of all other forms of natural capital: forests, soil fertility, marine fisheries, river ecosystems, etc. Putting restoration into practice in a world dominated by financial imperatives based on the old Industrial Revolution paradigm is, however, not going to be easy.

Perhaps one of the most promising approaches to the enormous task of reinventing business on a sustainable basis is that it can be done as a matter of "enlightened self-interest". The Natural Step (TNS) approach has been used
by Interface, Wessex Water, Yorkshire Water and a range of other businesses in the UK to integrate sustainable development into aspects of their businesses. TNS has at its core a robust scientific model of how a sustainable world operates, but it is also sufficiently pragmatic in its construction to support decisions based on self-interest (Holmberg et al. 1996; Everard 1998).

It is heartening that a number of leading companies, many noted throughout this article, are taking the message of "enlightened self-interest" to heart as a strategic approach to the sustainable development of their businesses. The benefit of tackling sustainable development as a strategic issue is that restoration of natural capital is essential, not merely to reinvest in the natural capitals upon which society relies, but also to maximise the "permission to operate" that society extends to businesses through legislation, reputation, resource distribution, consumer choice, etc.

Interface, the world's biggest manufacturer of carpet tiles and a major global manufacturer of office furnishings, has already made a long-term commitment to becoming sustainable. This commitment extends into becoming restorative as a matter of business urgency, reinvesting in the natural capitals upon which the business relies (Interface 1997). Practical policies stemming from this commitment include an intention to operate on fully renewable energy sources, to head towards zero emissions, to lease product as a means of "closing the loop" on resource recycling and reuse, and a range of other practical activities. By reinvesting in the natural capital upon which the company's success is based, Interface ultimately intends not merely to cease to deplete nature but to improve its capacities and diversity, thereby benefiting nature, society and its "permission to operate". This approach is a direct commitment to improving business through sustainability as a matter of "doing well by doing good".

Extrapolating this approach beyond Interface will not be an easy task. It is however an essential one. The hallmark of success will be gaining recognition that rich and diverse ecosystems are not a goal to be achieved at net cost on the back on improving economic competitiveness, but to be prized as an indicator of the health of an economy in balance with the natural capitals that sustain it.

Working towards sustainable solutions

Relatively few enterprises have taken the major step beyond "greening", defined by Everard (1999) as predominantly peripheral activities that do not touch core business decisions, into true sustainable development. However, there are just a few who have started to explore sustainable development as a serious issue across or in parts of their business. Not surprisingly, many of these are companies closely reliant upon natural resources, although there are some good examples more remote from primary resources.
Industries close to natural resources

Industries dependent directly upon ecosystem health have been amongst the first to recognise that the sustainable exploitation of primary natural resources is fundamental to their economic sustainability. Examples of this recognition include the enormous strides taken by the paper industry over recent years towards the goal of sustainable profit through sustainable resource management and manufacturing (Porritt 1998). Forest industries and those using forest products have joined together to establish sustainable stewardship schemes for both wood production and forest growth, including the Forest Stewardship Council (FSC), the UK Woodland Assurance Scheme (UKWAS) and the nascent Pan-European Forest Certification scheme (Tickell 1999). For marine fisheries, the Marine Stewardship Council (MSC) scheme has been led by WWF and Unilever, and is essentially a parallel of the FSC scheme, whilst there are plans for the establishment of a related Land Stewardship Council (LSC) for sympathetic land usage in agriculture (Tickell 1999).

Also, some water companies are amongst the first businesses in the UK to make public commitments to sustainable development (Wessex Water 1997; Yorkshire Water 1998; Thames Water 1999a, 1999b), with thinking extending not merely to continuity of supplies, but also to impacts on biodiversity, climate change implications and a commitment to renewable energy, ethical tariff structures, etc.

The manufacturing sector

The economic relationship between business and environment is also being recognised in industries more remote from primary resources. In the domestic products sector, Unilever has placed itself amongst the pioneers of truly sustainable resource utilisation by initiating a three-point plan aimed at the ultimate realisation of a sustainable company dedicated to meeting the needs of people world-wide (Unilever 1997). In the manufacturing sector, Interface has made a commitment to becoming fully sustainable whatever that may mean, not as an abstract or altruistic "greening" initiative, but as a core feature of its business development strategy (Interface 1997). As noted previously, this commitment extends beyond sustainability per se into restoration, as both an altruistic measure and the foundation for reinvestment in the natural and human capitals upon which future economic growth can occur.

Financial services

Even the financial services sector, apparently remote from primary natural resources, is waking up to the impacts of environmental unsustainability to business. For example, insurance and reinsurance companies now sponsor many of the climate change conferences world-wide owing to the potentially
huge economic implications of any adverse environmental or social consequences. British Coal, the UK's second biggest pension fund, has announced that its investment strategy will be guided by considerations of environmental impact, because poor environmental performance is likely to affect future profitability (reported in Green Futures 1999). The Cooperative Bank (1998) is also amongst the first UK companies to make a commitment to becoming fully sustainable as a business priority, tackling as a first priority its own ecological and social impacts but even offering preferential rates for more sustainable projects (as assessed through The Natural Step methodology) since they represent better risks. There is also a wider and growing realisation across the financial services sector that investment in schemes with poor environmental and/or ethical risk also represents poor economic risk.

Public perceptions about environmental and health issues are also exerting pressures upon business, for example recent British concerns such as genetically-modified organisms (GMOs) in food or the dumping of oil exploration platforms. However, in a wider sense, the "green consumer" as a major force appears, so far at least, to be more a myth than a reality (Unilever 1997).

No place for complacency

The purpose of highlighting these "high points" of progress towards sustainability is to emphasise that progress is occurring, and that effective sustainable development is not a remote concept. However, mindful of the data provided previously about declining natural capacity, there remains no room for complacency. Indeed, the need to accelerate progress towards sustainability through government, regional, business, local and personal decision, is never more pressing (UNEP 1999).

Science, policy and practice

Accepting that sustainability has a precise and scientific meaning, rather than comprising a set of loose and disconnected opinions as one could infer from the media, it is inconceivable that policies towards sustainable development could be constructed without an understanding of the way the world actually works. Science, then, ideally should be the foundation of sustainable policies, which should subsequently direct the practice of day-to-day business and government on a sustainable footing.

The ideal flow from science to practice

Of course, this ideal flow of science leading to policy thence to practice is not
the present norm. Vested interests, politics and perpetuation of habits are amongst a range of factors which cumulatively relegate science to a secondary role, rather than placing it at the foundation of wise decisions. Development of truly sustainable policies is therefore hampered by the twin aspects of declining use of science and the consequent declining investment in underpinning science. We shall return to this theme subsequently.

*Unsustainable policy in the aquatic environment*

Four examples are provided in this sub-section of the ways that UK policies undervalue the goods and services provided by freshwater resources.

(1). Point-source pollution control took a big leap forwards in England and Wales in the late 1970s when the focus moved towards the needs of the receiving water, as opposed merely to reflecting the nature of the pollution source (Everard 1994). This new *use-related* focus sought to protect the receiving waters as an environmental good, characterised by the uses to which society wished to put them. However, this approach falls short of sustainability in three primary ways.

(1.1). The investment infrastructure (Asset Management Planning or AMP) for present and future environmental investment by the water industry is explicitly geared to "hard" engineering solutions to control point sources of pollution. This hard engineering bias overlooks the sustainability impacts of the engineered works themselves (for example, greenhouse gases arising from pumping energy, chemical usage, or the physical footprint of the new or extended works). It also overlooks source control and other potentially more effective means for dealing with pollution reduction at source (Everard 1997a) as well as the wider benefits, and potentially lower costs, of "softer" solutions to maintaining or improving river quality, such as wetland and river habitat enhancements to stimulate biogeochemical "services" (Everard & Porritt 1997).

(1.2). The mathematical models used to support routine water quality planning activities treat rivers as simple channels conveying water from sources to the sea. Deductions about chemical quality in river stretches are derived from a few driving variables (e.g. river flow, upstream quality, consented effluent discharges and runoff from different types of land use), with generalisations about the behaviour of pollutants playing only a minor role. This simplification, whilst suiting the present "hard engineering" focus, substantially overlooks riverine and riparian wetland *services* and the capacity for habitat enhancement as a potentially cheaper and more sustainable mechanism to improve water quality and other aspects of the river environment (Everard 1997c).

(1.3). The cost-benefit assessment techniques, used to justify investment for protection of the goods deriving from maintaining or improving water quality,
are based on "conurbation" models of the uses that humans make of the environment. This results in the under-valuation of catchment areas remote from large human settlements (which are often of the highest conservation value), and the bias of interests in the remaining watercourses towards human utility and away from the life-support services provided by the river systems.

(2). Only in recent years have river management policies begun to consider the whole drainage basin in river management, although agricultural, development planning and other policies remain all too often isolated from the needs of healthy catchments. In particular, the hydrological continuity between river and floodplains is not adequately considered in management policies. As an example, Everard (1997a, 1997b) notes the apparent disregard for wetland services in the developed world, and the offset of the loss of these services by expensive and potentially unsustainable water resource, flood defence, water quality and habitat engineering downstream. Consequently, conservation measures tend to overlook the wider social and economic benefits of improved river quality, also tending towards spatial approaches that preserve remnant habitat in a mid-successional state rather than protecting the processes that maintain river structure, habitat dynamism and ecosystem services (Everard 1997b).

(3). Arising from the Biodiversity Convention signed at the "Earth Summit" at Rio de Janeiro in 1992, the Biodiversity Action Plan process in the UK has been valuable in identifying and prioritising those species and habitats that are under the greatest threat. All species-specific and habitat-specific plans are costed. However, this approach fails to escape the trap wherein nature and its ecosystems are perceived as a net cost rather than an invaluable capital.

English Nature's updated position statement on sustainable development reaffirms that biodiversity is a key test of sustainable development, requiring the highest level of protection (English Nature 1999). However, this too fails to note that biodiversity is not merely a key indicator, but is also the very asset that supports a thriving economy and social wellbeing.

(4). The "Polluter Pays Principle" is another helpful historic development that recognises not only that business has impacts on the environment, but that those profiting from that business should bear the costs of environmental protection and remediation. The principle has served a valuable function and will continue to do so as business slowly changes from the Industrial Revolution paradigm into new ways of thinking.

However, in striving for true sustainability, it is important to go beyond mere reparation for damage, and the capability to be able to fund increasing environmental damage through increasing profitability or market share, and to seek genuinely sustainable resource utilisation based wholly on carrying capacity of the environment. Indeed, recent Government thinking on this issue
(as reflected in both DoE and Welsh Office 1993 and DETR and Welsh Office 1998) suggests that improvements in the environment can be paid for on the back of a strengthening economy. This argument is fatally flawed in the assumptions that the economy exists in isolation, and that the supply chains leading to supermarket shelves, factories and power and water supplies do not themselves depend ultimately upon unsustainable utilisation of natural and human resources here and overseas.

By conveniently overlooking the resources underpinning economic systems, we can blind ourselves to their upstream dependence upon ecosystem goods and services, but sadly not insulate ourselves from the longer-term social and economic consequences of declining "environmental headroom".

Collectively, the above approaches have, in the past, all reflected substantial progress towards sustainable development. However, each also has shortfalls in the delivery of truly sustainable development. Their common flaw is that the goods and services provided by fresh waters are considered "downstream", as a net cost rather than as valuable and irreplaceable resources.

**Turning costs and benefits upside down**

Ecosystems are the source of the goods and life-support services that not only maintain life but also support economic and social health. However, present economic systems and policies treat the environment as a net cost; something to be funded on the back of business, and overlooking the umbilical dependence of business upon human and environmental capital. The challenge of sustainability then is to embed two concepts which, collectively, turn upside down the present economic paradigm: (a) ecosystems are the source of natural capital, not simply a matter of net cost, and (b) healthy ecosystems are a wise investment increasing "environmental headroom", and are absolutely not something that can be purchased when the economy is healthy.

**Restoring the importance of science**

Sustainable development is of course about what we actually do, not merely about fine ideas and rhetoric. In an ideal world, technologies and practice would be based on wise and sustainable policies, informed by the science of the way the world operates. Indeed, it is difficult to envisage how real progress towards sustainability could be made without robust science to inform the decision-making process.

**Devaluation of the role of science**

However, we are not yet in this ideal world. Policy, as is widely known, is a matter also of politics and vested interests, and this has relegated science from
its invaluable leading role in directing thought towards sustainability. During the 1990s, and perhaps exemplified by the UK Government's White Paper *Realising Our Potential* (OST 1993), public spending on scientific research was explicitly linked to economic competitiveness based on the limited economic horizon of GDP. The net result was a contraction in "blue skies" and pure research, with a re-emphasis on near-market applied research and a general contraction of public expenditure on science.

The simultaneous elevation of sustainable development as an international priority and political "buzz word" presented an odd juxtaposition of Government policy, on the one hand calling for a more sustainable future whilst on the other stifling our capacity to discover the scientific foundations upon which sustainable policies should be built. The present vociferous debate about genetically-modified organisms demonstrates that the lack of independent, publicly-funded research leaves decision-makers with inadequate information on which to make sound decisions, and generates public mistrust of scientific work conducted by business as a matter predominantly of the rapid commercialisation of new technologies (Everard & Ray 2000).

*The critical role of aquatic science*

As a critical limiting resource, both domestically and world-wide, fresh waters should at this time be one of the highest priorities for research expenditure. However, Hildrew (1993) highlights the reduced research output and loss of capacity of freshwater science in the UK over recent years, a trend confirmed by Jones (1994). This declining trend in underpinning science, at a time of ever-more urgent needs for sustainable policy, is of deep concern.

*Advocacy from the scientific community*

Merely reiterating these concerns will not of itself result in enhancing government commitment to science funding, nor changing policy. As a matter of some urgency, I therefore advocate freshwater scientists from all disciplines to use their influences - through government and regulatory advisory panels, to politicians and policy-makers at all levels, in local groups, press articles, and the numerous other networks in which they become involved - to convey four key messages about the central role of the freshwater sciences in achieving sustainable development.

(1). Sustainable development can only be achieved through a scientific understanding of the hard biophysical limits of nature's life-support capacities.

(2). Social needs and wealth creation are supported by ecosystem goods and services, and will unavoidably suffer if nature's limits are overridden.
(3) Investment in pure research into critical systems such as fresh waters, including their contribution to social and economic health, is therefore a matter of economic competitiveness and social advantage.

(4) Healthy ecosystems are an indicator of the life-support and future economic capacity of the UK. Restoration of these systems is therefore a pressing priority, not to be viewed as a matter of net cost, to be prioritised only when economic conditions are favourable, but as a matter of wise investment in the future.

Acknowledgements

I would like to thank Dr Jacqueline Vale for her assistance with this paper and with the conference presentation. Thanks also to Dr Ben Pontin for locating some helpful references, and for his comments on the draft of this paper.

References


6th Meeting of the Conference of the Contracting Parties, Brisbane, March 1996.


