

HISTORY OF CONSERVATION AND BIODIVERSITY

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Summary

Biodiversity as a word and as a concept has literally exploded into the popular psyche and into academic literature in about twenty years. Yet the meaning of the term and the significance of related issues are often misunderstood whilst its general reference to the diversity of life and species is clear. Since its first usage biodiversity has become inextricably intertwined with nature conservation and to a degree with ideas of sustainability.

However, why and what we choose to conserve, and indeed how successful our attempts are, remain enigmatic. Ideas of conservation and biodiversity become mixed with implied issues of ‘wilderness’ and of ‘nature’ and ‘naturalness’. But it is increasingly recognized that much of the biodiversity which we may hope to conserve is in fact the result of a long interaction between people and nature. It is a ‘*cultural ecology*’, the product of the environment, history and tradition.

1. An Introduction to Biodiversity and its History

Interactions between people and wildlife, both plants and animals, can be problematic. In many cases and across all continents, the human footprint is evidenced by catastrophic change and mass species extinctions. Today the process goes on and with human-induced climate change for example, the consequences may be even worse than previous impacts. Yet despite the damaging impacts of people on the environment and its ecology, it is clear that in pre-industrial, often subsistence societies there is an intimate long-term relationship between people and nature. Indeed, much of the ecology which we now value is present as a result of the continuity of traditional management approaches over hundreds and sometimes thousands of years. Even a cursory look at history shows that in recent centuries humankind has been rushing headlong towards urbanization and industrialization, with by the early twenty-first century over half the global population being city-dwellers. Agri-industry and agri-forestry have replaced traditional farming and woodland use, and the process of ‘*cultural severance*’, separating people from direct dependence on nature has swept in. This is what the present author calls ‘*the end of tradition*’ and is likely to cause loss of biodiversity as significant as that from say climate change or other major environmental shifts. Yet so far, this threat to conservation has crept in with barely a murmur and most environmentalists remain unaware of the defining shift in the ecological resource.

To understand the problems we need a good knowledge of the broad issues of biodiversity and its changes through time, both natural and human-induced. However, it is also necessary to learn from history and to be able to relate human activities, economies, politics and cultures, to the changing landscape and its ecologies. From this base we can then consider the development of what we now term nature conservation and how this impacts on and even reflects the changes in the biodiversity resource. If we can gain effective insight into these processes we can then question the degree to which we have real impacts and effects. In essence, are environmentalists merely spectators who catalogue the changing kaleidoscope of nature, or do we have a real and tangible impact on the outcome? History tells us that the changes we see over centuries are reflections of deep-seated politics and economics within society; issues of supply and demand, of competition, exploitation and abandonment. This suggests that in order to alter the processes and to influence the outcomes of change in order to achieve effective nature conservation then activities must be at political and economic levels within society. If this is the case then in a democratic system it is likely that there will be serious challenges in terms of effective engagement and empowerment of people and communities in determining the nature that they desire. Indeed, these tensions are already emerging as nature conservation organizations themselves become large land-owning corporate bodies of professionals with views and agendas often imposed down on local communities rather than reflecting the aspirations of local people.

Much of the modern conservation work is of the highest excellence and has achieved restoration and remediation on a scale which twenty years ago would be inconceivable. Yet in terms of achieving genuine sustainability and a halt to human-induced biodiversity losses much of the work is fundamentally flawed. Almost all the nature conservation work is dependent on short-term grant aid and subscription-based voluntary groups and very little is embedded in long-term economic or political

processes. There is little understanding by key stakeholders of the cultural nature of the resource or of the likely implications of cultural severance on biodiversity. Furthermore, there are significant issues about the lack of accountability or democracy in the determination of policies and agendas by many of the significant players. But without effective local '*ownership*' of environmental and conservation projects, any hopes of long-term sustainability must be questionable. The evidence of history and the lessons of the past inform our view of the present and the potential futures. With escalating urbanization and still growing human demands on the planetary resource the challenges will continue to raise the stakes in the environmental lottery.

Ecological diversity changes with the environment and with time, varying spatially and temporally. Over the last few millennia human impacts either directly on wildlife and vegetation, or indirectly on the environmental resources, have had major influences on ecological diversity. Each phase of human development, from hunter-gatherer, to settled agricultural communities, to industrialization and urbanization, has wrought increased human impacts on ecology and environment. Human impacts have increased dramatically in recent centuries and in the last few decades, and the effect on habitat destruction and species loss has led directly to concerns over loss of '*biodiversity*'. This was a term coined by the American ecologist E.O. Wilson in the 1980s (1998, 1992), and which has gained widespread recognition albeit with much misunderstanding across a broad arena of debate. Whilst the impacts of early human land-use, such as forest clearance and localized agricultural intensification were undoubtedly significant and dramatic, it is in the last 500 years that the colossal scale of change has become widespread and the effects so deeply engrained. The first big impacts of forest clearance and agricultural probably began around 5,000 years ago in areas of relatively dense population, such as around the Mediterranean and in China. There were devastating periods of drought, erosion of fertile soil, and probably major floods associated with human impacts. The deterioration of the environmental resources clearly had dramatic consequences for communities dependent upon them, but the overall effects were generally relatively localized. It is in more recent times human impact has been on a scale that can only be described as immense. This has been driven by twin processes of industrialization and urbanization, and related to these both the capability and the necessity for agricultural intensification and industrialization. It is reasonable to say that today there is no place on the planet which is not in some way affected or modified by human-related change. Human activity triggered mass extinction of fauna and flora on a scale previously unprecedented excepted in the most dramatic environmental catastrophes such as meteor impacts, mega-volcanic eruptions, and ice ages. In recent years it has also become clear that people are changing and have changed the planetary climatic condition. The debate still rages as to the precise cause and even the nature of the change but that change has occurred and a significant part is driven by human activity is clear and indisputable.

The realization of these massive impacts and of the likely or at least potential effects on the environment and what we now call '*sustainability*' has become widely accepted. Because of the increasingly visible and tangible damage to the environment and to people there has been a gradual emergence of concern and even fear about the consequences of unrestrained exploitation. Whilst this has developed gradually over the last two hundred years or so, particularly in Europe and in North America, it has

emerged as a protest force and even as a political movement in the last few decades of the twentieth century and during the early years of the twenty-first. Yet concerns over ownership, use and custodianship of natural resources go back to the earliest organized communities. In animals, and especially in humans, territorial zones, often manifested as tribal areas, have been essential to survival. Much human behavior and many aspects of social etiquette are based around the establishment and protection of a resource-base. This is sustainability and survival at its most basic with communities closely and obviously dependent on their immediate natural resources. With time the human population has increased dramatically and in parallel the natural resources on which it depends have been eroded and reduced. With this scenario it has become increasingly important for individual communities to protect and ensure the survival of their resource capital, the basis of their existence. For the earliest settled communities it was increasingly vital to establish their particular niche and then avoid over-exploitation, and also to protect their resources from the depredations of competitors.

Such attempts to manage and control vital environmental assets have had mixed success over the millennia. History tells a story of over-exploitation and collapse of societies and civilizations, and of catastrophically changed environments. However, there have been successes, although many systems of resource use were not long-term sustainable. In many cases careful management regimes evolved, refined and rigorously enforced, resulted in increased production of needed material resources, from fuel-wood, to timber, to food. This was sometimes possible over long periods of time, and coppice woods for example may have evidence of active management for more than a millennium. However, whilst some systems of exploitation allowed a resource to be produced over centuries or more, they were not necessarily benign in terms of the environment. Indeed they often caused major and irreversible changes in the resource. The original ecology was often radically changed; landscapes were modified almost beyond recognition. These changes are so deeply ingrained and indeed fundamental to many ecosystems that many of our now most precious wildlife species are co-evolved with the human systems of exploitation. The flora and fauna of traditionally managed grasslands and commons, from hay meadows to pastures are examples of these rich cultural systems. But when tradition ceases and economically-driven management ends, the landscape and its associated biodiversity deteriorate. This theme will be re-visited later.

Yet many exploitation systems have proved fatally flawed and as a result societies and even major civilizations collapsed. Underneath many if not all of the world's most extensive deserts for example, lie the ruins of a failed civilization; they over-exploited their resources and perished as a consequence. Forest clearance around the Mediterranean led to serious shortage of essential fuelwood and timber and declines in early civilizations. The clearance of upland forest and the cultivation of lands in Britain can be evidenced by down-washed sediments in lowland floodplains and areas such as the East Anglian Wash. Over-exploited in Bronze Age and Iron Age times, the skeletal soils simply eroded and leached away to leave a nutrient-depleted ecology and a permanently changed landscape. Over-use of Spanish forests in medieval times meant the loss of timber needed for ship-building and a long-term decline in both economic and political power. In many if not most cases the consequences of such catastrophes have proved long-term and irrecoverable.

Humans exploiting, foraging in and managing environmental resources have influenced ecosystems and biodiversity for millennia. Competition for resources has also been pivotal in the balance between different communities and civilizations. Indeed the impetus of gaining specific resources was often the key driver for conflicts and conquest. This was the case from the Roman Empire to European imperialism and expansion in the post-Renaissance period and beyond.

2. Natural Variations in Ecology and Biodiversity

Not all fluctuations in ecological diversity are attributable to human activities. Observations of natural ecosystems show how ecology varies spatially with environmental variables like soil, geology, water, topography and aspect, and climate. Variation also runs through time as distribution and ecological successions generate change, and over longer time-periods through processes of evolution and extinction.

This latter point leads to one of the key misunderstandings in terms of extinction and biodiversity. A common and popular fallacy is that since extinction is '*a natural process*' and '*species have always come and gone*', then human-induced destruction of wildlife is itself '*a natural process*'. Whilst species loss can be a natural process the key issues are the *rates* of extinction and the *scale* of human-induced losses, and especially of recent impacts. The recent changes amount to a mega-extinction and although it is true that mass extinctions have occurred previously, they have generally been associated with globally catastrophic events such as meteor impacts, mega-volcanic eruptions, and long periods of ice age. The present rates of human-induced extinction are comparable with those of earlier catastrophes. This should be a salutatory fact and not a reason for complacency.

3. The Imprints of Environmental Change on Biodiversity

One of the most obvious influences on biodiversity, and of great concern today, is climate change. The effects of long-term climatic fluctuations are visible in ecosystems around the globe. Furthermore, the impacts of human-related changes in for example, forest cover and the spread of deserts through over-grazing, are frequently inter-locked with natural fluctuations. These changes are then reflected in biodiversity at every level from local and regional to global. One of the most pertinent examples of climate change and changed biodiversity, especially for those in the Northern Hemisphere, is the so-called '*Little Ice Age*' from the 1400s to the 1800s. It is worth considering this episode in a little more detail.

4. An Example of the '*Little Ice Age*'

The causes of the major deterioration in the climate of the Northern Hemisphere are still disputed. However, whatever the reasons, the result was a period of several centuries of incredibly harsh cold weather. It is difficult to be precise about the scale and the nature of the impacts on biodiversity because there was almost no scientific recording and therefore very little evidence of the detailed ecology of the time. However, it is clear that wildlife was squeezed out of northern regions and into more southerly, warmer areas. There must have been significant losses of climate-sensitive species particularly

in the northern areas. We get some idea of the likely changes through the retreat of the growing areas for particular crops and fruits such as the Grape Vine (*Vitis vinifera*), and also the widespread failures of harvests across Europe during this period. Some indication of biogeographic trends can be seen in the southward spread of northern species such as for example the Hooded Crow (*Corvus corone cornix*) and its more recent retreat back north. Other sources of information are locked away in the paleo-ecological archives of peat bog profiles in which the loss of warmth-requiring beetles as the icy grip of the Little Ice Age squeezed them out. Similarly there may be evidence from long-lived trees such as Small-leaved Lime (*Tilia cordata*), of previous climatic conditions and of extreme events. The evidence is relatively thin and it is also hard to separate the climatic trends and induced changes from those caused by other aspects of landscape change including human agricultural practices.

The suggestion would be that northern and boreal species of plants and of wildlife would have spread south during this time and that southern thermophilic species would have moved south too, and many may have been lost. Certainly if we consider a national biodiversity resource such as that of the British Isles, then there would have been undoubted gains and losses on a large scale. The extent to which the European fauna and flora would have gained or lost is very difficult to predict.

5. Volcanoes, Floods and Coastal Erosion: The Effects of Some Other Major Environmental Impacts

Global and regional biodiversity has been grossly affected by the impacts of major volcanic eruptions, by both direct regional or local effects of volcanic ash, gas clouds and lava, and by the discharge of particulates to the high atmosphere which caused intense periods of cold and dark weather. Some of these events are now known to have caused huge suffering amongst human populations and the abandonment of, for example, more marginal settlements in upland areas. They must have impacts on biodiversity, but aside from the obvious removal of fauna and flora in the immediate vicinity of a volcanic eruption, there is little known about the detailed effects on biodiversity. Edward Wilson (1992) discusses the likely implications of the known major volcanic events on biodiversity. He also considers the impacts of major meteor impacts and of course these are now recognized as being responsible for mega-extinctions of fauna in prehistoric times. One of the major events of this kind occurred around 66 million years ago and was responsible for the extinction of the dinosaurs. Whether this was a single event or perhaps a series of smaller meteor impacts and also volcanic eruptions is still, debated. Extinction did not happen all at once but was spread out over a few million years.

Fluctuations in sea level have also occurred since the first oceans were established on the Earth. It is considered likely that major and cataclysmic sea level changes and consequent flooding occurred in the early periods of the emergence of major civilizations and are 'recorded' in the flood mythologies and folklore around the world. The most widely-recognized are the accounts of the biblical flood which may relate to the post-glacial filling of the Mediterranean and then the Black Sea as the Atlantic rose and water poured through to inundate the previously dry basins. Again we can only speculate as to the impacts on ecology and biodiversity of events of such magnitude.

However, flooding and sea level related changes have occurred throughout history and prehistory. The East Coast of England for example has suffered major periods of inundation, of coastal zone erosion, and also of massive deposition and accretion. All these have affected the ecology and biodiversity of the region. Even the process and pattern of change have influenced our contemporary fauna and flora, as for example, Britain was cut off from continental Europe by rising water around 7,000 years ago. The precise timing of sea level rise was hugely influential set against the process of northward re-colonization of animals and plants in the post-glacial period as climate generally warmed. The Pine Marten (*Martes martes*) was a mammal, a mustelid, which made the move in time to get across before the English Channel closed and is a part of the British fauna. The Beech Marten (*Martes foina*), its southern cousin failed. The tiny Harvest Mouse (*Mycromys minutus*), our smallest mammal is believed to have crossed what is now the North Sea in the reed-like vegetation which lined the path of a great river running across the shallow flatland between Europe and Britain.

Areas of massive coastal flooding would be changed totally and some zones became wetter and other areas gained new ground. Such regions would have had extensive marshes and flats, and also vast areas of dynamic sand-dune systems with all their various successional stages. It is likely that many of the species adapted to such dynamic landscapes were the so-called ruderals, often today's 'weeds'. The present-day natural habitat of such species has often diminished, though as noted by Oliver Gilbert (1989, 1992) they or their cultivated descendants are often important in urban commons and other disturbed environments. Indeed, the successional changes and sequences of a regenerating urban or post-industrial disturbance site were compared by Gilbert to those of the post-glacial re-colonization of Northern Europe; albeit telescoped in time sequence from many centuries down to a few decades.

6. The Ecological Footprint of the Human Race

It is generally accepted that the major process of re-colonization of the Northern Hemisphere reached its zenith around 5,000-6,000 years ago, with many of today's main vegetation zones and ecosystems in place. However, since that time, with both successional change and in response to long-term and short-term climatic fluxes, the situation has remained dynamic. Species' distributions across the region and hence the biodiversity of any one area have changed dramatically over the centuries. In trying to assign species and biodiversity to specific areas or regions, it is sometimes hard to take the inherent dynamic nature of the resource into account. Such changes occur today, with for example the spread of collared dove across Europe from the East during the latter half of the twentieth century, and the more recent colonization, or re-colonization, of Britain by Little Egret (*Egretta garzetta*) and Cattle Egret (*Bubulcus ibis*). Despite such changes it is clear that the basic structures and diversity of ecology across Northern and Western Europe were in place by a period perhaps several thousand years ago. Since that time, when human activity was relatively limited and had effects through the use of fire, and also through indirect impacts via influences on large grazing herbivore behavior, the human footprint has become massive. Early peoples certainly influenced the landscape and as in North America, the selective hunting of large game would definitely influence savannah and forest growth, species and patterns. Yet potentially important though some of these influences might have been, the phases of human social

development that followed make the earlier impacts seem miniscule. There is still a debate about the nature of this primeval landscape across North Western Europe, and the discussions centered on the seminal work of Frans Vera (2000), have helped to clarify how the early landscape might have looked and perhaps aid the understanding of how their biodiversity relates to that which we see today.

Our vision now is not one of wall-to-wall forest, but of more open plains or savannah with a rich diversity of other landscape and ecological components too. Much of this variation would be related to basic environmental factors like climate and water-logging, but Vera's key factor is the importance too of large grazing herbivores. Not everyone agrees with Vera's hypothesis, but the argument is compelling and a refined version of his original vision has a considerable body of supporting evidence.

The landscape had vast expanses of wetland, marsh, fen and peat bog with extensive coastal wetlands too. Dense woodland and thickets would grow up in the protection of rings of prickly Blackthorn and Bramble and here would be the plants and animals that characterize our so-called '*ancient woodlands*' today; the Bluebell (*Hyacinthoides non-scripta*), Dog's Mercury (*Mercurialis perennis*), Wood Anemone (*Anemone nemorosa*), and Yellow Archangel (*Galeobdolon luteum*) for example.

Outside the prickly halos of the thorns was a wide open savannah with heath, grassland and giant old trees such as Pedunculate Oak (*Quercus robur*), to ages of a thousand years or more before collapsing into oblivion.

A further powerful driver of succession and change in this landscape would be pre-human fire caused by lightning strikes which would take out the great trees in the open plain. Further north and into the upland zones there would be a change to landscape dominated by great and similarly ancient Scots Pines (*Pinus sylvestris*), and again a strong influence of natural, lightning-related fires.

Mountain zones would have large areas of disturbance through natural landslip and erosion areas, and all the great rivers would include sometimes vast floodlands and meandering patterns of erosion and deposition in an ever-changing yet stable landscape. Much of this environment would have limited amounts of available nutrients, especially nitrogen and phosphorous, and this too had a great influence on associated biodiversity.

Localized areas such as mountain downwash zones and alluvial fans would have higher nutrient levels, and the whole landscape would have abundant micro-disturbance through natural process, but only limited macro-disturbance.

Erosion and deposition areas, animal-related disturbance, fire, and successional and life-cycle related changes such as the collapse of ancient trees provided a template for a richly diverse fauna and flora with regionally distinct ecologies related to broad climatic influences and localized geological and topographic factors.

This was the landscape, the ecology and the biodiversity upon which the footprint of human activity would be stamped with increasing effect over the following five to six thousand years.

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Biographical Sketch

Ian Rotherham was born in Sheffield (UK) in 1956. He graduated in Ecology from the University of Lancaster and then was awarded his PhD in botany from the University of Sheffield. He is Professor of Environmental Geography and Reader in Tourism & Environmental Change at Sheffield Hallam University. He has written over 400 papers and articles and a number of books. His research includes landscape history, the economics of landscape change, issues of invasive alien species, and aspects of tourism development.