A BRIEF CONSIDERATION OF GEODIVERSITY AND GEOCONSERVATION

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ABSRACT

Most people associate nature conservation with the protection of biodiversity. Geoconservation, or the conservation of geodiversity, is an area of nature conservation which is not as well understood, but this appears to be changing.

Across the world the emphasis in nature conservation has been on the conservation of fauna and flora whilst virtually overlooking the geological, geomorphological and pedological foundation on which the biological world has evolved. The need for nature conservation is widely accepted by biologists, other natural scientists and the public in general.

Earth scientists are not trained in conservation theory and have had little input into the development of conservation strategies and policies, particularly as they relate to geoconservation. The majority of earth scientists are trained and employed by industry. To be involved in conservation could be seen to be contrary to the goals of the profession. This need not be the case.

There is a very close link between geodiversity and biodiversity and a holistic approach to the conservation of natural diversity can be achieved by managing and conserving both the living and non-living aspects of the natural world. Biodiversity is reliant on geodiversity and ecosystems also depend on their non-living parts be they bedrock, landforms or soils to function properly.

Where geoconservation values have been recognised there has been a tendency to concentrate on the spectacular (for example karst, active volcanic and glacial sites), scientifically significant (for example type sections) or those with biological evolutionary links (for example fossil sites). There are over five hundred and fifty World Heritage Areas in the world and, of these thirty nine have been listed for their geoconservation values. These generally include biological values.

Geomorphological or landform features can be impacted by developments such as excavation because the shape of the feature can be altered. Quarrying or mining can actually be of benefit to geoconservation by exposing significant geological sites which would not otherwise be visible. Rehabilitation of quarries and mine sites can also impact on geoconservation values by obscuring significant geological exposures.

Geoconservation in perspective

The need for nature conservation is widely accepted by biologists and other natural scientists. This is understandable, given that development in general has had impacts and still threatens biodiversity across the world. An increased rate of extinction has also occurred, over the last few hundred years and there was a realisation early on that this needed to be addressed. Geodiversity (see appendix for definitions) has not always been considered in the same way and has typically been seen as providing an opportunity for the provision of natural resources. Clearly there are aspects of the biological world which are viewed in a similar manner.

Most tertiary biology courses include studies of conservation biology. Earth scientists are not trained in conservation theory and have little input into the development of conservation strategies and policies, particularly as they relate to geoconservation. The majority of earth scientists are trained and employed by industry. To be involved in conservation could be seen to be contrary to the goals of the profession. This need not be the case. In Tasmania there are a number of management agencies which have specific policies and procedures in place to conserve and manage activities that may impact on geodiversity.

There is a strong argument for the conservation of geodiversity given that many geological features have formed under climatic or geological conditions that are now inactive. They are essentially relict or “fossil” features which, once disturbed, will never recover or could be removed forever.

There is also a good reason for emphasising a broader approach to conservation because there is a very close link between geodiversity and biodiversity. From the initiation of life on earth there has been a need for geodiversity and biodiversity to interact. The earliest recorded fossil, stromatolites from the Streeley Pool Chert in the Pilbara, are thought to be 3.45 billion years old. Since that time geological processes have controlled biological evolution and directly contributed to natural extinction events such as the dinosaur extinctions at the Cretaceous/Tertiary boundary about 60 million years ago. The interaction between the living and non-living world over all of this time is self-evident.

A holistic approach to the conservation of natural diversity can be achieved by managing and conserving both the living and non-living aspects of the natural world. Biodiversity is reliant on geodiversity and ecosystems are also depend on their non-living parts be they bedrock, landforms or soils to function properly.

Many sites of geoconservation significance have minimal or no influence on current ecological processes and it is quite appropriate to manage them in an isolated fashion.

Background and history of geoconservation in the world

Geodiversity is not used as a way of trying to mimic (Joyce 1997) the term biodiversity. Clearly there are major differences in the way the biotic and abiotic worlds evolve and reproduce. The term is used so as to ensure all aspects of the abiotic environment be they geological, geomorphological or pedological are considered.

The protection of geodiversity is not a new arm of conservation but has generally kept a fairly low profile. It is as logical as other forms of conservation, be they natural or cultural, and has been around for over 100 years in Tasmania and for

about as long in Europe, New Zealand and the USA where the western concept of conservation has its roots (Dixon 1995).

In the United States park system geology and geomorphology are given great prominence particularly in interpretation (Dixon 1995). This is not surprising given the spectacular nature of features such as the Grand Canyon, Yellowstone and the Hawaiin Volcanoes. Yellowstone was reserved in 1872 primarily because of its remarkable geological features. National Monuments (generally a bit smaller than National Parks) also have outstanding natural values and include sites such as Mt St Helens, Craters of the Moon and Dinosaur National Monuments.

New Zealand has a long history of nature conservation starting in 1887 with the creation of the Tongariro National Park covering active volcanoes. It also has reserves covering landforms such as karst, geothermal, igneous, mineral, fossil and soil sites. They also have a geopreservation inventory covering over 3500 sites (Dixon 1995).

The science of geology developed from the study of outcrops in the United Kingdom during the 18th and 19th centuries, particularly in Scotland. It also has some of the earliest evidence for the protection of sites of geoconservation significance. Aggazis rock in Edinburgh; a glacially striated rock was preserved by the city council in 1840.

In Australia the conservation of significant earth features has its roots in the protection of important cave sites in the 1870's. In the 1960's the South Australian branch of the Geological Society of Australia campaigned to protect the Hallett Cove site (McBriar and Hasenohr 1994). In the mid to late 1970's most States developed inventories of geological monuments with a strong bias towards bedrock geology (Dixon 1995). In the late 1980's earth features gained an increased profile in consideration for World Heritage listing and contributed to nominations for the Tasmanian Wilderness World Heritage Area (Dixon and Pemberton 1991), the Blue Mountains, Lake Eyre and Nullarbor regions.

The more recent (1997) listing of Macquarie Island WHA, Heard and Macdonald WHA and the Australian Fossil Sites (Department of Environment, Sport and Territories 1993 and 1996, 1993, Creaser 1994) shows that there is political precedent in Australia to list abiotic sites. Macquarie Island provides a good example of how difficult it is to get a site listed for geoconservation values alone. The problems occurred at the international level with the IUCN whose original assessment was inappropriate as it focused on biodiversity when the case was not being made on biological grounds.

Where conservation values for geological features have been recognised there has been a tendency to concentrate on the spectacular (eg karst, active volcanic and glacial sites), scientifically significant (eg type sections) or those with evolutionary links (eg fossil sites). There are about five hundred and fifty world heritage sites in the world and of these thirty nine have been listed for their geoconservation values, some of which like the Great Barrier Reef also have biological values. Gray (2004) considers that from a geodiversity perspective the World Heritage List under represents world geodiversity with a tendency for the spectacular (mountains, volcanoes and caves) to dominate the list of 39 listed at the highest level for geoconservation values.

Threats to Geodiversity

Most people would consider that earth features are rugged and do not need to be managed. There are however examples from Tasmania where these features have been lost or impacted by a variety of developments (Bradbury et al 1995, Dixon 1996, Kiernan 1989, 1991, 1996 and Sharples 1998). Disturbance or removal of most earth features is normally permanent unless we are willing to look at sustainability over millions of years, and even then, this does not allow for the recreation of features that may have formed under particular geological or climatological conditions.

Abiotic features in contrast to biotic or living things are typically fossil or develop so slowly that degradation is permanent and destruction, or extinction, of an important site can occur with the passing of one bulldozer blade, the removal of specimens, by collectors for example, or poor land management (Pemberton 1997).

In Tasmania examples of earth features which have been lost or impacted include;

• The loss of 28 Tertiary and Quaternary fossil sites destroyed or inundated. This represents approximately 50% of the sites identified in the last 100 years.
• Impacts on significant geological sites in road cuttings.
• Collection for research resulting in the removal of valuable or rare fossil stumps and Thylacine subfossils from caves.
• Rare or significant minerals collected.
• Three out of over 50 lunette features left in an undisturbed state.
• Flooding of the globally unique Lake Pedder.
• Erosion of significant fluvial landforms on the Gordon River.
• Moraines bulldozed in the Mersey valley.
• Damage to the Exit Cave System, magnesite tower karst destroyed in the mid 1980's and degradation of spring mounds in the NW.
• Infestation of coastal dunes by marram grass altering natural processes and removing mobile sand from the system.
• Soil erosion following fire including impacting on peatlands of international significance.

In order to protect geodiversity we need to understand the threats and how they can be avoided or minimised. There is a need to have active geoconservation inventories and a commitment to manage and monitor these sites. The approach to nature conservation should include an approach encompassing all natural values and processes.

Geomorphological or landform features can be impacted by developments such as excavation because the shape of the feature can be altered but the quarrying or mining industries can actually be of benefit to geoconservation by exposing significant geological sites which would not otherwise be visible. Rehabilitation of these sites can sometimes impact on geoconservation values.

Communication and education

In Australia many natural and reserved areas are considered to have very important geoconservation values including places like Uluru, Kata Tjuka, Wave Rock, the Twelve Apostles, the Nullarbor, Wilpeena Pound, Wolf Creek Crater, Geikie Gorge, Undara lava tubes and the Great Barrier Reef. To highlight the significance of these features it is important that the geological story of how they

developed through deep time is told. This could lead to a better appreciation of the importance of geodiversity.

To assist with the communication of the fascinating history of the earth and our continent to the large majority of people, who find deep time truly daunting, the links between geodiversity and biodiversity need to be emphasised. This would assist people to value the non-living environment. It would facilitate a greater appreciation of natural diversity and provide a pathway for the general public to better understand the complexities and wonders of the geological history.

The story of our natural diversity, the links between geodiversity and biodiversity and how it has all evolved should be explained to the masses.

Conclusion

Geodiversity can be impacted by some developments and it is important to ensure representative features are conserved or appropriately managed to avoid impacting on the features integrity. A range of sites have developed under climatic or geological conditions which are now inactive and impacts on them can be irreversible.

The ability to manage and protect sites in Tasmania has improved significantly in the last decade and similarly there has been progress in the United Kingdom, New Zealand, America, Canada and other parts of Australia. Developing inventories and accessible databases of significant sites is a first but very important step to manage significant sites. These assist to locate the sites, identify how robust or fragile they are and how they should be protected.

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Appendix - definitions

Geodiversity

The natural range (diversity) of geological (bedrock), geomorphological (landform) and soil features, assemblages, systems and processes.

Geoconservation

The identification and conservation of geodiversity for intrinsic, ecological or heritage values.