

# CONSERVING GEODIVERSITY, THE IMPORTANCE OF VALUING OUR GEOLOGICAL HERITAGE

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## Abstract

Most people associate nature conservation with the protection of biodiversity. Quite clearly there is a lot more to nature, and to conservation, and this is where geoconservation or the conservation of geodiversity needs to be promoted and taken more seriously. It will assist to communicate the fascinating history of the earth and our continent to the large majority of people who find deep time truly daunting.

The need for nature conservation is widely accepted by biologists and other natural scientists. However nature conservation agencies and governments across the country, and overseas, tend to emphasise the need for the conservation of biodiversity whilst virtually ignoring the geological foundation on which this is built and has evolved. In part this is because of a lack of pressure on the part of earth scientists who 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 in the extractive industries. To be involved in conservation could be seen to be contrary to the goals of the profession by some.

The case for conserving geodiversity may, in some respects, be more important than biodiversity given that, in a lot of instances, rare or threatened species can be propagated or bred in captivity. On the contrary many geo features have formed under conditions, climatic or geological, that are now inactive. They are essentially relict or "fossil" features which, once disturbed, will never recover or will be removed forever. If this was the case for biodiversity there would be enormous concern.

If we can not afford to lose biodiversity there is an equally strong case to be made for conserving geodiversity. Ecosystems depend entirely on their non-living parts be they bedrock, landforms, soils or related processes. Geo features can also have their own values irrespective of their relationships with biodiversity. However there would simply be no biodiversity without geodiversity. The story of our natural diversity, the links between geodiversity and biodiversity and how it has all evolved needs to be explained to the masses. This is a powerful way of improving communications in the earth. There are few better places than in our National Parks and other natural areas.

Where conservation values for geo 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). Biological conservation has a much broader, representative approach. Of the five hundred and fifty two World Heritage Areas in the world thirty six have been listed for their geo values. These are generally layered with biological values. Only three have been listed for geo values other than (active) volcanic, fossil, glacial and karst values. These sites are Gros Morne National Park in Canada, the Devils Causeway in Ireland and Macquarie Island.

The emphasis on valuing our natural environment has been dominated by biological values. The links between geodiversity and biodiversity would assist people to value the non-living environment. This would facilitate a greater appreciation of natural diversity and provide a pathway for the general public to better understand the complexities and wonders of our geological history. Concentrating on communicating our attitudes, philosophies and practices to the wider community may not be the only approach. We should try to nurture a respect and appreciation of the earth's evolution and its building blocks.

Geodiversity and geoconservation.

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The case for conserving geodiversity may, in some respects, be more important than biodiversity given that, in a lot of instances, rare or threatened species can be propagated or bred in captivity. On the contrary many geo features have formed under conditions, climatic or geological, that are now inactive. They are essentially relict or “fossil” features which, once disturbed, will never recover or will be removed forever. If this was the case for biodiversity there would be enormous concern. “

Conservation is generally considered to be about looking after living things which is perplexing given that, used or protected appropriately, these are the things which are capable of reproducing and being replaced if they are over exploited. Very little attention is given to the non - living or abiotic world where reproduction does not occur and loss, removal or impact on features integrity is permanent at least in the context of a human or many human lifespans. The loss or extinction of a landform or significant geological site normally does not rate a mention although something with biological connections such as a fossil site may attract attention, particularly if it is the remains of a dinosaur.

In Tasmania recently a person found guilty of removing quartz crystals of Devonian age from a cave received a \$50 fine. That equates to a fine of about a cent for every million years. Interesting also to note that this material was stolen from the Tasmanian Wilderness World Heritage Area, an area with the highest possible level of conservation status.

Geodiversity is used not as a way of trying to mimic (Joyce 1997) the term biodiversity in any way. 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, etc are considered. Geodiversity includes the range of geological, geomorphological and soil features, assemblages, systems and processes.

What is geoconservation? It involves the protection of geodiversity and is not a new or radical arm of conservation. 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 arguably the western concept of conservation has its roots (Dixon 1995).

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 sites, geothermal, igneous, mineral, fossil and soil sites. They also have something called 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 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 Hawaii 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 heritage values and include sites such as Mt St Helens, Craters of the Moon and Dinosaur National Monuments.

Geological and geomorphological features have been valued for many thousands of years by indigenous Australians. They were obviously a part of their every day life but also formed important landmarks for navigation, provided shelter, art sites, burial locations and places to sit and consume meals.

In Australia the conservation of significant earth features has its roots in the protection of important cave sites in the 1870's. Very little happened until the 1960's when the South Australian branch of the

GSA campaigned to protect the Hallett Cove site (McBriar and Hasenohr 1994). A national convenor was appointed in 1974 and 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 feature gained an increased profile in World Heritage issues and contributed to nominations for the Tasmanian Wilderness World Heritage Area (Dixon and Pemberton 1991), the Blue Mountains, Lake Eyre and Nullabor regions.

The recent 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 commitment to listing abiotic sites. Macquarie Island provides a good example of how difficult it is to get a site listed for geo values alone. The problems occurred at the international level with the IUCN whose original assessment can only be described as being seriously biocentric. There are five hundred and fifty two world heritage sites in the world, of these thirty six have been listed for their geo values, which are generally layered with bio values. Of these only three have been listed for values which are not (active) volcanic, fossil, glacial or karst. These sites include Gros Morne National Park in Newfoundland, the Giants Causeway in Ireland and Macquarie Island.

Geoconservation in Tasmania really took off in the late 1980's with the employment of a permanent, fulltime earth scientist in the Parks and Wildlife Service and a geomorphologist in the Forestry Commission whose main responsibilities are the protection of geodiversity. Tasmania is the only conservation agency in the country with a fully functional Earth Science Section, which is committed to the day to day management and protection of geodiversity but equally important to ensuring a fully integrated approach to nature conservation.

#### Threats To Geodiversity

Most people would consider that earth features are rugged and do not need to be managed. There are however many examples from Tasmania where such features have been lost or severely 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. In other words in the abiotic or non-living world, in contrast to biotic or living things, features 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. Most of these are under impoundments while some are under playing fields.
- Destruction of significant geological sites in road cuttings. These include an eclogite site in the Tasmanian Wilderness World Heritage Area.
- 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 undisturbed in the midlands.
- 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 from quarrying, magnesite tower karst destroyed in the mid 1980's, degradation of spring mounds in the NW resulting from agricultural and residential development.
- Infestation of marram on coastal dunes altering natural processes and removing mobile sand from the system.
- Soil erosion following fire including impacting on peatlands of international significance.

## Nature conservation – a natural approach

The practitioners of nature conservation used to be naturalists and their study meshed all aspects of the ecosystem and somewhere the two were separated. To be serious and consistent about nature conservation there needs to be a return to the approach where the entire natural environment is considered not just the above ground or living part of the environment. Geological features and processes contribute to biodiversity, and are some of the determining factors in biodiversity. They are important and significant from this point of view but also in their own right (Dixon et al 1997).

The need for nature conservation is widely accepted by biologists and other natural scientists. However nature conservation agencies and governments across the country, and overseas, tend to emphasise the need for the conservation of biodiversity whilst virtually ignoring the geological foundation on which this is built and has evolved. In part this is because of a lack of pressure on the part of earth scientists who are not trained in conservation theory and have had little input into the development of conservation strategies and policies (Parks and Wildlife Service 1995), particularly as they relate to geoconservation. The majority of earth scientists are trained and employed in the extractive industries. To be involved in conservation could be seen to be contrary to the goals of the profession by some."

Most earth scientists (including geologists, geophysicists, geomorphologists, pedologists etc) have been trained to contribute to extractive industries such as mineral exploration, agriculture, forestry, etc. or have remained in academia. Compare this however with the biological sciences and cultural heritage conservation or cultural heritage management where graduates aim to pick up employment in conservation or similar areas. These courses are often directed towards conservation whereas earth scientists are not necessarily trained to "think" like this. This has generally meant that geoconservation has remained something of an oddity, divorced from mainstream nature conservation, and so it has generally had low priority within land management agencies.

This is not anyone's fault but clearly people of the earth, those working in the earth sciences or those interested in geoconservation must consider their responsibilities to protect and preserve geodiversity and our geoheritage.

This also needs to extend beyond the traditional geological monuments or significant geological features approach. This concentrates on conservation values relating to scientific research, reference and education, which are given as the main reasons given for protection (Eastoe 1979). It is an approach which has less relevance to broader issues of land management and ecological sustainability or to important links with other nature conservation values. It also virtually ignores currently active process sites.

Controversy raged in the GSA through the early 1990's over a "Policy on geological heritage in Australia with suggestions that such activities were "outside the Society's interests, and even perhaps against the interests of the geological profession in Australia" (Joyce 1994). Despite this the policy was adopted in 1992. It confirms the view that sites can only be significant in terms of scientific or educational use values and appears to emphasise geological features. This narrow interpretation of significance may be appropriate for the GSA but it only encompasses part of the aims of conserving geodiversity (Dixon 1996). It sets unreasonable objectives for most divisional subcommittees to identify, document, evaluate and assist in the management of sites and does not recognise that relevant expertise may reside with non-GSA scientists.

The conservation of geodiversity should include the following values defined by Sharples (1993);

**Intrinsic values** - Protecting or conserving a feature because it exists and is a value in itself rather than only because of some value humans may put on it. This concept is widely accepted in nature conservation circles but it is considerably harder to justify where values are only considered for scientific or aesthetic values to humans.

**Ecological values** - The ecological value of a thing or process is its importance in maintaining natural systems and ecological processes of which it is a part. It is essential that the common understanding of ecology and ecosystems as relating to the biotic environment only is erroneous and that the terms embrace abiotic features as well.

Human - centered values – The direct value of geological, geomorphological and soil systems to humans – those elements of geodiversity which are of significant value to humans for non-extractive purposes which do not decrease ecological or intrinsic values. These include scientific, research and education sites or sites which inspire people because of their aesthetic qualities or features which are significant in the role they play in cultural or spiritual values of particular communities.

A broader approach to the conservation of geo values has a better chance of being accepted by the community. Arguably they would more readily embrace the concept if it was linked with bioconservation and the conservation of natural diversity. Treating the entire natural environment as an intricately related system is quite logical from a land management and conservation perspective and quite obvious from the way the natural environment works.

Clearly many old geo sites have minimal or no influence on current ecological processes and it is quite appropriate to manage them in an isolated fashion. This should not be seen as the only way to manage sites. It has the potential to immediately marginalise virtually all current process sites and sites where bedrock, soil (Pemberton 1997) and landforms have a major influence on biological dynamics. Current process sites have been seriously under represented in Australia inventories of significant sites.

In order to protect geodiversity we need to understand the threats and how they can be avoided or minimised. We also need to have active additions to inventories and a commitment to manage and monitor these sites. The approach to geoconservation should not be a reductionist approach just to avoid controversy. It should be a broad approach encompassing the sites in their entirety and the broad range of natural features.

There appears to have been a reluctance to identify sites of geoconservation significance in Australia which are not traditional geological monument type sites, for example, sites with broader ecological implications. This may be a result of inadequate knowledge or could be a consequence of concern regarding the extent of sites, a situation that may alienate industry or government. With the correct approach and explanation there is no reason for these fears.

#### Communication and education.

In Australia many natural and reserved areas are considered to have very important geo values including places like Uluru, Kata Tjuta, Wave Rock, the Twelve Apostles, the Nullabor, Wilpeena Pound, Wolf Creek Crater, Geikie Gorge, Undara lava tubes and the Great Barrier Reef. But how often do the public know what they really are or how often are they told what the features are and how they formed. In a number of instances there are explanations which cover some of these sites but nowhere near as often as bio interpretation. Just as there is respect for the biological resources on earth there needs to be a swing to a similar respect for geodiversity. As earth scientists I am sure that most of us continue to be awed by the things we see in our field work or the things we find during the wide variety of work we undertake.

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 our geological history. Concentrating on communicating our attitudes, philosophies and practices to the wider community may not be the only approach. We should try to nurture a respect and appreciation of the earth's evolution and its building blocks.

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## Bibliography

- BRADBURY, J., CULLEN, P., DIXON, G., & PEMBERTON, M., 1995: Monitoring and management of streambank erosion and natural revegetation on the lower Gordon River, Tasmanian Wilderness World Heritage Area, Australia; *Environmental Management*, Vol. 19, p. 259 - 272.
- CREASER, P., 1994: Australia's World Heritage fossil nomination; In: O'Halloran, D., Green, C., Harley, M., Stanley, M. & Knill, J. (eds), *Geological and Landscape Conservation*, Geological Society, London, pp. 75-77.
- DEPARTMENT OF ENVIRONMENT, SPORT & TERRITORIES, 1993: *Nomination of Australian Fossil sites by the Government of Australia for Inscription on the World Heritage List*; Department of Environment, Sport & Territories, Canberra.
- DEPARTMENT OF ENVIRONMENT, SPORT & TERRITORIES, 1996 *Nomination of Macquarie Island by the Government of Australia for Inscription on the World Heritage List*; Department of Environment, Sport & Territories in association with Parks & Wildlife Service, Tasmania.
- DIXON, G., 1995: *Geoconservation: An International Review and Strategy for Tasmania*; A Report to the Australian Heritage Commission, Occasional Paper No. 35, Parks & Wildlife Service, Tasmania.
- DIXON, G. & PEMBERTON, M., 1991: Earth science conservation - It's time; In: *Abstracts*, 5th Regional Seminar on National Parks & Wildlife Management, Tasmania, 1991.
- DIXON, G., HOUSHOLD, I., PEMBERTON, M., & SHARPLES, C., 1997: Geoconservation in Tasmania: Wizards of Oz!; *Earth Heritage*, No. 8, July 1997, p. 14 - 15 (published by English Nature).
- EASTOE, C.J., 1979: *Geological Monuments in Tasmania*; A Report to the Australian Heritage Commission, by the Geological Society of Australia Inc., Tasmania Division (Reprinted 1986).
- JOYCE, E.B., 1994: Geological Heritage Committee; in: Cooper, B.J., & Branagan, D.F., (eds): *Rock me Hard...Rock me Soft...A History of the Geological Society of Australia*, Geological Society of Australia Inc., p. 30 - 36.
- JOYCE, E.B., 1997: Assessing geological heritage; In: Eberhard, R., (ed.), *Pattern and Process: Towards a Regional Approach to National Estate Assessment of Geodiversity*, 1997 Technical Series No. 2, Australian Heritage Commission & Environment Forest Taskforce, Environment Australia, Canberra, p. 35 - 40.
- KIERNAN, K., 1989: Landform conservation in Tasmania; In: Fensham, R. (ed.), *Threatened Species and Habitats in Tasmania*, Department of Geography and Environmental Studies, University of Tasmania, Hobart.
- KIERNAN, K., 1991: Landform conservation and protection; *Fifth Regional Seminar on National Parks and Wildlife Management, Tasmania 1991, Resource Document*, Tasmanian Parks, Wildlife & Heritage Department, p. 112-129.
- KIERNAN, K., 1996: *Conserving Geodiversity and Geoheritage: The Conservation of Glacial Landforms*; Report to the Australian Heritage Commission.
- McBRIAR, E.M. & HASENHOR, P.V. (eds), 1994: *Geological Monuments in South Australia, Part 8*; Geological Monuments Subcommittee of the SA Division of the Geological Society of Australia Inc.

PARKS & WILDLIFE SERVICE, 1995: *Geoheritage and Geoconservation - Discussion Paper and Policy*; Parks & Wildlife Service, Tasmania.

PEMBERTON, M., 1997: A brief consideration of soils and their conservation significance; In: Eberhard, R., (ed.), *Pattern and Process: Towards a Regional Approach to National Estate Assessment of Geodiversity*, 1997 Technical Series No. 2, Australian Heritage Commission & Environment Forest Taskforce, Environment Australia, Canberra, p. 59 – 63.

SHARPLES, C., 1993: *A Methodology for the Identification of Significant Landforms and Geological Sites for Geoconservation Purposes*; Report to Forestry Commission, Tasmania.

SHARPLES, C., 1998: Landform Conservation Progress in Tasmanian Forestry Management; in: Bliss, E., (ed), *Islands: Economy, Society and Environment*, Conference Series No. 19, New Zealand Geographical Society, p. 447 - 450.