KARST MANAGEMENT IN WA
– AN OVERVIEW OF THE CURRENT SITUATION

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ABSTRACT

There are a range of environmental management techniques, laws and policies that have been directed towards protecting and conserving some aspect of the environment. The conservation and protection of karst systems is an important issue that needs greater consideration and attention. The development of management plans and policy can play a significant role in the protection and conservation of karst systems. The state of W.A. has many karst systems, with differing land tenure. As such, these areas also have a wide variety of karst management. The areas within Western Australia which are karstic include: the Nullarbor, the Kimberley Region, the Cape Range, and the south-west coastal calcarenites – including the Wanneroo cave belt near Perth, and the Leeuwin-Naturaliste Ridge.

This paper will briefly examine the range of instruments that are available in relation to protection and conservation of all aspects of karst systems. The paper will outline the policy instruments relating specifically to karst systems that exist in Western Australia. The focus of the paper will be on wholistic karst management and management techniques currently being utilised, on a regional basis. The final Section of this paper will examine the effectiveness of current management techniques and policy and make some recommendations for future direction.

There is an opportunity for the Commonwealth and State Governments to set some clear policy regarding karst systems. It would be excellent if the agencies and organisations could work together in the management of karst. It is encouraging to see the progress that has been made, however there are opportunities for the development of further important policies in an integrated manner regarding this significant environmental issue. There is also further opportunity for both the public and the government to be involved in protecting and conserving karst systems. It is the author's view that karst management in WA could benefit from increased collaboration and consultation. There is also a need for more education and interpretation of karst areas.

INTRODUCTION

As an ASF member, my interest in caves has broadened from the protection of caves (and their ecosystems and specialized fauna) to karst management in general. In my role as a WA Conservation Commission Co-convenor I have been able to represent speleological groups on a number of committees. This led me to further my interest in karst management by undertaking postgraduate study (in karst management). Recently I undertook a subject titled "Protected Area Policy". As such, I have examined research on environmental policy and karst related policy. The major policy instruments are outlined here to assist in raising your awareness of the topic in general. I hope that, by the examples I provide, you will be challenged to find out about your state and karst area.

If you are unfamiliar with the concepts of environmental policy or Australian legislative responsibility then I suggest you find out more. I would be happy to provide some useful references or point you in a direction. Basically, the State governments have the principal legislative responsibility for natural resource management – developing legislation, policies, standards and guidelines.

The Environmental Defender's Office (EDO 2001) outlined that environmental law is derived from five sources – common law, statute, subsidiary legislation, administrative policies and international law. Although not laws themselves, policy and administrative guidelines are important. Statements of planning policy are examples of policies and guidelines that affect the way that law is practically applied. Policy is also important in that it can drive implementation of legislation.

There isn't the time to deal with each aspect in great de-

PHOTO: CAMERON ELDRIDGE

One of several karst features in a significant karst system at risk of damage due to a lack of appropriate policy regarding karst systems in W.A.

tail, so this paper is a preliminary presentation of the main policy instruments in relation to karst management in WA. A list of the Commonwealth, national and local policy instruments is in Appendix A. Aside from specific 'karst' policy – aspects of karst can be covered under environmental policy categories – ie the flora, fauna, water may obtain protection from other avenues. Appendix B outlines some of these other policy instruments that may relate to WA karst systems.

THE ISSUE – PROTECTING AND CONSERVING CAVES AND KARST

Caves occur in a range of geological areas and have a broad range of definitions (Jones et al 2003). Generally the majority of caves occur in karst. The term "karst" has been described by several authors to refer to a special type of landscape that is commonly characterized by caves, subterranean drainage and closed depressions. It is known that karst landscapes are formed primarily by the solution of rock, most commonly limestone (Gillieson 1996). Other authors emphasise the complex and integrative nature of karst by referring to a karst system as incorporating component landforms as well as life, energy, water, gases, soils and bedrock (Yuan 1988, Eberhard 1994). Thus karst is a result of a complex interplay between a number of complex factors – These include: geologic, pedologic, climatic, topographic, hydrologic, biologic and temporal factors (Hamilton-Smith et al. 1998).

Some of the most recognized attributes of karst are caves and underground streamways. Some authors refer to surface and subsurface components of a karst system. However, the key concept is that of a unified system that is dynamic, interactive and interrelated. Yuan (1988) outlined how karst systems are difficult, if not impossible, to restore once degraded. Thus these environments need a range of policy instruments developed to protect them.

Water plays a key role in karst systems. Kiernan (1998) explained that the cornerstone of successful karst management is a recognition of, and successful response to, the need to maintain the natural regime and quality of the fluids that flow through karst (both the gases and liquids). Hamilton Smith et al (1998) further added that the *"quality of any karst environment is most importantly dependent upon the integrity of the catchment and aquifer"*: (1998:39).

Examples of areas within Western Australia which are karstic include: the Nullarbor, the Kimberley Region, the Cape Range Province in the Exmouth area, and the coastal calcarenites – including the Wanneroo cave belt near Perth, and parts of the Leeuwin-Naturaliste Ridge.

Subterranean fauna are a special feature of karst systems. The Department of Environment (DOE) (2004) outlined some of the issues associated with karst areas in W.A. The DOE also provides an excellent outline of some of the threats to the environmental values of karst.

ASPECTS TO CONSIDER

Many people think of caves as a discrete environment that is 'there' for some aspect of their recreation. The majority of Australians would have visited a tourist cave and can easily relate to the beauty and aesthetic value of karst environments. However, within the population there would not be a wide understanding of the importance of karst and the varying reasons for its protection.

Traditionally, humans have had a number of uses for caves and the resources contained within karst systems. Archaeological and palaeontological records indicate sites of historical or cultural significance – art sites, burial sites, habitation sites, water resources or the preservation of materials such as bones. The geological aspect of caves and karst systems also needs consideration. The geological resource, such as limestone, can be quarried and used in industry. The minerals in karst may also have uses to humans. The biological aspect of karst systems also needs consideration – the rock may be a special habitat for subterranean creatures that have adapted to that environment. Karst is also an aquifer and thus an important source of water for many people.

PHOTO: ROSS ANDERSON

Local speleologists examining a subsidence in a new development caused by runoff from a local road.

Therefore, there needs to be a range of policy instruments to cover a variety of aspects within a karst system. As discussed earlier – each aspect of a karst system needs to be considered in relation to the others, as karst is a 'system'. There are a wide number of issues and aspects that need consideration in policy development.

CHALLENGES AND OPPORTUNITIES

As with any environmental issue, there can be a number of challenges and opportunities involved in protecting and managing the natural environment. There is a need to ensure that karst systems are managed in an integrated manner, where the surface and subsurface are considered together. Many karst areas are managed purely as 'surface' environments with little consideration of issues such as surface impacts on the subsurface or of catchments impacting on the system as a whole.

Due to the nature of the issues outlined, and the fragmentation of government agencies, no single government department is responsible for policy regarding karst systems. Some government agencies will have internal policy documents relating to karst, while other agencies will have some statutory responsibility for an aspect of the karst system. There are other agencies that develop karst policy for a particular area in relative isolation or for a particular issue (ie development on a karst area). In the majority of situations, policy on broad issues such as sustainability, vegetation, threatened species and wetlands can also be utilized in relation to karst systems in some areas.

Other challenges involve balancing resource use with resource protection – ie quarrying versus conservation reserves. In some situations a conflict in land use may arise – such as infrastructure or housing development in a karst area versus agricultural use or conservation of the area. Other conflicting uses can be that of recreational caving within a karst system

– ie in a national park. Not only are there access issues ('who' can access 'what') but also visitor impact issues. Other issues such as vandalism, damage or visitor risks are issues that need consideration in policy development, implementation and evaluation. Thus the areas of conservation of the specific environmental issue will inter-relate with recreational issues, tourism, resource abstraction and industrial uses of karst systems. There is an opportunity for both the public and the Government to be involved in protecting and conserving karst systems. There is a need for more education and interpretation of karst areas. There is a need to educate everyone on 'why' these special areas need protection, and also in educating those who manage land (private or government) on 'how' to protect and conserve karst systems. In relation to Australia, a lot can be learnt from looking internationally at how other countries deal with this specific environmental issue in relation to policy.

KARST MANAGEMENT

Hamilton-Smith et al. (1998) stated that 'success' in managing karst depends upon recognition of the need for it to be managed as a total integrated and dynamic system" (1998:3). It could be stated that, in Australia, there is a lack of understanding of what karst is, how it forms, its dynamic nature and why its management needs are so specific. The issues facing both users and managers of karst systems are summarized in more detail in Kiernan (1988). Thus, management of karst systems needs to take into consideration all of the components described previously – the climate, topography, soil, vegetation, catchments characteristics, biology etc,

Specific land management issues in karst areas include: groundwater use; urban use – development and planning – roads housing, infrastructure; mineral use – quarries; cave use – recreational and tourism; scientific research; biology and habitats. It is the author's recommendation that karst areas are managed using styles of management such as an integrated catchment management approach or ecosystem management approaches. Given the need to manage karst systems in a wholistic manner, there needs to be a range of policy instruments available.

RESOURCE CONSERVATION ISSUES

Hamilton-Smith et al. (1998) state that *"the fundamental tenet of karst management is to protect the whole karst hydrogeologic system"* (1998:46). This will require the integrated management of the karst system and its catchment area. Karst areas occur throughout Australia, on a variety of land tenure. In many areas there are many resource uses operating, some of which are potentially conflicting uses. Protecting and conserving karst systems involves more than just a blanket creation of a national park or a reserve over an area. The management of karst areas involves numerous agencies, groups and individuals working together. The development, implementation and evaluation of policy in relation to karst systems play an important role in karst systems management.

It must be acknowledged that there is a great deal not known in relation to a number of karst areas. As such, Hamilton-Smith et al (1998) outline that any planning policies should be conservative in nature, simply because the environmental impacts of mistakes will be difficult or perhaps impossible to correct. Jones et al (2003) outline that cave protection entails considering three aspects: physical contents of the cave, cave life and the hydrological aspects (including catchment). These authors also referred to 'cave protection' as entailing: controlling access to the cave and controlling land use practices (both directly above the cave and in the entire watershed). Thus is can be seen that there are a wide range of issues that need to be considered when policy instruments are utilized, developed and implemented for caves and karst systems.

KARST RELATED POLICY

On an international level, there are well-developed bodies of policy and practices relating to conserving and protecting caves and karst systems. In particular the IUCN guidelines (Watson et al. 1997) are a useful document that is specifically relating to protecting karst systems. I hope that all cavers are familiar with the IUCN "Guidelines for cave and karst protection". It outlines that *"the establishment of protected areas is not, in itself, enough to ensure karst protection"* (1997:16). Additionally, the guidelines stress that *"more than in any other landscape, a total catchment management regime must be adopted in karst areas"* (1997:20). You may be familiar with the term integrated management or integrated catchment management. As cavers and speleologists, we need to keep in mind that this is what is required for management of karst systems.

At an Australian level however there are no specific Federal policy instruments in relation to karst systems. At a State level, there is no legislation or complete policy instrument that deals with protection or conservation of caves and karst systems. There are fragmented policy documents at an administrative level only – dealing with a particular aspect of a karst system. Some policy documents exist to deal with one specific karst area. Appendix A contains a list of the Federal, State and local policy instruments that are relevant to the protection and conservation of caves and karst systems – particularly with respect to caves and karst systems in Western Australia.

Commonwealth

The Commonwealth Constitution gives specific law making powers to the Commonwealth Parliament. The Commonwealth Government plays an important role in environmental regulation – especially in control of interstate and overseas trade and external affairs. A major development in commonwealth environmental law making was the passage of the *Environmental Protection and Biodiversity Conservation Act* (EPBC Act) in 1999. The other paper that I present at this conference outlines this in more detail (Anderson 2005). I encourage cavers to be familiar with the EPBC Act.

State

In the State of WA there are a wide range of government agencies involved in policy development and implementation regarding conservation of karst systems. As discussed in the introduction, each of these agencies will play differing roles, depending on their level of responsibility. The Commonwealth institutions have overall legal responsibility and have developed a number of policies. Implementation of these policies is by State agencies. At another level, the State agencies develop policy. In WA, for example, regarding wetland conservation, this would primarily be the Department of Conservation and Land Management (CALM) and the Department of Environment (DOE). However the other government departments listed also have involvement: The WA Planning Commission (WAPC) and the Environmental Protection Authority (EPA). At a more regional level are the local governments – such as the City of Wanneroo and the Shire of Joondalup.

A quick Internet search by the author gave several direct statutory references in WA to caves or karst. There are no statutes containing the word 'karst', but the word 'cave' appeared several times – primarily in the State legislation under the *CALM Act 2002*. Part 2 of the CALM Regulations 2002 titled 'Protection of the Environment' (S14, S29, S39, S49, S75 and Division 7) relates to caves. Prior to the implementation of this legislation, caves had some reference in statute under the *Parks and Reserves Bylaws Act 1972* (Pt 4, Pt 15, Pt 17). These policy instruments relate to consequences for unauthorized access to caves, smoking in or damage to caves. In particular, a specific land tenure type is covered by these documents – caves and karst on CALM land.

Other references relating to 'caves' were in regard to sections of land that had been reserved. In WA, there are several Acts that are relevant to environmental protection and conservation. These are listed further in Appendix B.

Once example of policy in relation to water (that has some relation to a specific karst area) is that of the Gnangara Mound and the karst system north of Perth. The EPA has been in the process of evaluating policy in relation to water resources. The Draft Environmental Protection (State Groundwater) Policy 1998 is a policy instrument that was prepared by the EPA for public comment but its implementation has been delayed pending amendments to the *Environmental Protection Act*. This policy provides a framework for avoiding degradation of groundwater quality and quantity throughout the State.

The WA Planning Commission (WAPC)

The WA Planning Commission (WAPC) is part of the Department of Planning and Infrastructure. The WAPC prepares and adopts statements of Planning Policy (SPP) under statutory procedures set out in Section 5AA of the *Town Planning and Development Act 1928*. The WAPC and local Government must have due regard to the SPP provisions when preparing or amending Town Planning Schemes and when making decisions on planning matters

There are a number of policy instruments – including Statewide, Regional and Metropolitan policy instruments. Statewide policy documents include – State Planning Strategy and Livable Neighbourhoods Strategy. Metropolitan Strategies include Bush Forever. The WAPC also has a policy manual on subdivision and development control policies. The Statement of Planning Policies Amendment 2003 was published to renumber and update a new classification system. Relevant SPP to karst systems include those relating to: State Planning Framework Policy, Environment and Natural Resources Policy, Peel-Harvey Coastal Plain Catchment Policy, Gnangara Mound Crown Land Policy, Basic Raw Materials, Agriculture and Rural land Use Planning, State Coastal Planning Policy and the Leeuwin-Naturaliste Ridge Policy.

There are no SPP relating specifically to caves or karst systems. Some SPP are semi-related in that the areas referred to contain a karst area. This includes the Gnangara Groundwater Protection Policy 11/2003; the East Wanneroo Rural Land Use and Water Management Strategy (LUWM), the Gnangara LUWM Strategy and the Greater Perth (Future Perth) plan. Regional Policies include the Carnarvon-Ningaloo Coast Regional Strategy and the Gingin Coast Structure Plan. Both of these policy documents have a karst system contained within the region being referred to. These documents all have relevance in that a karst system will occur within a region and needs to be considered in policy that is developed. The

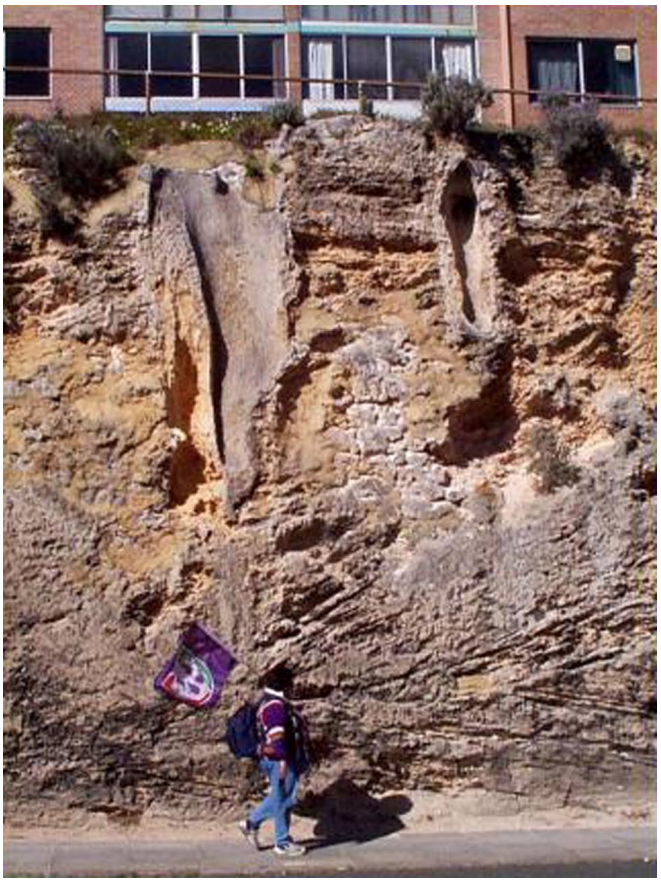

PHOTO: JAY ANDERSON

An example of the close proximity of urban development to karst systems in the Perth metropolitan region.

WAPC Act 1985 is the overarching document in regards to planning issues.

RECOMMENDATIONS

- That the WAPC develop a specific SPP regarding karst systems.
- That existing SPP – for regions that contain karst – are revised to consider the karst within that region and associated catchment issues.

THE ENVIRONMENTAL PROTECTION AUTHORITY (EPA)

The EPA is an independent statutory authority and is the key provider of independent environmental advice to the WA Government. The EPA's objectives are to protect the environment and to prevent, control and abate pollution. The EPA has a number of policy instruments relating to environmental protection and to environmental quality criteria. There are Environmental Protection Policies (EPP) and Position Statements and Guidance Statements. The EPA published a series of position statements that set out its views on matters of environmental importance. EPPs are prepared in accordance with Part III of the *Environmental Protection Act 1986*. Once approved by the Minister for the Environment this policy has the force of law, as through it had been enacted as part of the Act. Thus, EPPs are statutory policy documents that are required by legislation. There is no EPP in relation to caves or karst systems.

The EPA's most significant policy type of document is a Position Statement. These are principle policy statements. There is not a position statement of karst or karst systems in general. The EPA has developed 8 position statements. The

first Position Statement developed was, however, regarding a specific karst area – that of Cape Range (EPA 1999). This document contains sections relating to biological diversity, offshore islands, coral reefs (Ningaloo Reef), landscape, social and cultural aspects and karst and subterranean fauna. The EPA principles regarding environmental assessment and decision-making for the Cape Range Province are significant and the author feels that they should be broadened and related to all karst environments.

Tacey (2004 pers. comm.) outlined that the EPA has not logically developed Position Statements. They have been developed in a 'responsive mode' and by adaptive planning processes – ie as a need arises then a policy is developed. It is the author's belief that these principles should be broadened and applied to karst systems in general. It is clear that the EPA needs to develop a Position Statement regarding karst systems in general.

Guidance Statements (GS) are developed by the EPA to provide advice to proponents and the public about the minimum requirements for environmental management that the EPA would expect to be met when the EPA considers a proposal during the assessment process. (EPA 2004). Tacey (2004 pers. comm.) stated that the GS are quite specific policy documents that list procedures or performance indicators that are required. The EPA has a number of guidance statements. Only one of these relates to karst (EPA 2003). Guidance Statement number 54 is a policy instrument that specifically addresses the conservation of stygofauna in groundwater systems and troglofauna and stygofauna in subterranean caves. The EPA objectives are to ensure the adequate protection of important habitats for these species.

The EPA released a policy document in 1997 titled 'Guidelines for Environment and Planning'. This document is now in the process of being reviewed. The original document did not relate to karst directly or at all. In the last 7 years, the EPA has become more aware of the importance of karst systems and the need to consider this specifically in developing policy instruments. As such, the evaluation of this policy document is now to include a section on karst systems. The new policy is to be titled 'Guidance for Planners in local authorities and State Government'. In February 2004, speleological groups were involved in consultation on this draft document as a specific stakeholder (EPA 2004). This new policy instrument will incorporate aspects on a range of environmental factors – such as vegetation, fauna, wetlands and karst. The Guidance document was planned to be released for public comment around the end of August 2004 (Perry 2004 pers. comm.), however it is still being developed.

RECOMMENDATIONS

- That the EPA develop a specific EPP regarding karst systems.
- That the EPA develop a position statement regarding karst systems.
- That Policy Document 54 be revised to fully relate to troglobitic fauna (currently it specifically relates to stygofauna).

THE ROLE OF LOCAL GOVERNMENT

The Western Australian *Constitution* requires a system of local government to be maintained throughout the State. This is obtained through the *Local Government Act*. Local governments make local laws and develop policy and exercise important powers under the *Town Planning and Development Act* and the *Health Act*. A Regional example is focused on for this section with examples given of policy instruments in the City of Wanneroo (north of Perth).

The City of Wanneroo implemented a local rural strategy in 1999. It contains a section on 'Special Planning Area No.3 (PPA No.3)' 'caves and karstic areas'. There are 7 main policy points and an action cited in this particular policy instrument. Some karst areas may be protected in that they are identified as 'landscape protection' in the Metropolitan Rural Policy 1995 and the North West Corridor Strategy Plan (DPI Policy documents). The City of Wanneroo TPS (and the District Planning Scheme (DPS) No. 2) has some considerations for karst. However, this is a basic, simple document that needs to gain strength from proper implementation. It is recommended that this document be reviewed to consider the karst system as an integrated system. It is also recommended that further reviews of this document include consultation with speleological groups.

As outlined above, there is a wide range of policy instruments regarding the environment, specifically karst systems. The majority of these instruments fall into the category of statute or administrative policy instruments. The extent to which these policy instruments have been evaluated or reviewed varies greatly. Likewise, the extent to which development of policy documents has included speleological consultation.

RECOMMENDATIONS

- That the City of Wanneroo LES document be reviewed to consider the karst system as an integrated system.
- That further reviews of the LES document include consultation with speleological groups.

ANALYSIS OF POLICY

As discussed there is only a small range of policy instruments regarding karst systems in W.A. There are some much-needed alterations and reviews required on current and existing policy documents. The government agencies do not have specific karst knowledge or experience in the development of such specific policy. In the majority of policy development there has been little consultation with speleological groups or with specific individuals who have karst systems knowledge or experience. It is only in recent times that the importance of karst systems has been recognized and that speleologists are becoming more involved in the development of policy and in the public consultation process. It is the author's opinion that there is a lot more 'room for improvement' and that the consultation between government and specialist stakeholder groups (such as speleologists in karst areas) should be more formalized.

The policy in relation to karst areas in WA has only been developed in the last decade – or is still being developed. As such, this is a relatively new field of specialist policy. It would be excellent if the government could look to other countries' policy instruments as an example and to assist in the future development of policy documents.

There are several regulatory instruments in WA. However, these are not comprehensive and do not generally relate directly to karst systems. There are no economic instruments. In relation to establishing protected areas – these occur mostly at a government level with government land. Karst systems are protected in national parks or conservation reserves – this is not a holistic or representative system. The government

needs to develop policy instruments to encourage private landowners to establish protected areas on their own properties. In summary, the Government is only really just starting to utilize education as a policy instrument. At a Federal level, Geoscience Australia has recently undertaken a project on 'Karst Hazards' and produced an information booklet. This is a first step on a necessary process of education. Traditionally, speleological groups and environmental/conservation groups have played a large role in environmental education. Thus, there is much more to be achieved with a range of policy instruments.

On the whole, the author considers that there are lots of gaps in policy and plenty of opportunity for developing integrated policy instruments.

There is scope for such policy instruments as economic incentives – taxation incentives or subsidies – ie to encourage landowners to undertake conservation covenants or appropriately manage land and to protect karst systems. In respect of visitor impacts, there is an opportunity for an integrated approach to managing and protecting karst systems in Australia. The government needs to develop appropriate regulatory policy instruments to assist in the protection of the important cave and karst systems.

The author notes that in existing policy instruments, the policy goals have not been clearly stated. The author realises that the regulatory instruments regarding karst primarily exist for the protection of the environment. However, there is a variety of factors involved that make the situation complex. Thus, policy instruments involving planning, development, resource use or recreation may not reasonably be compatible with environmental protection. Thus, the current mix of policy instruments may not be fully effective in achieving policy goals.

FUTURE DIRECTIONS

The WA Conservation Commission 2004 Report to the ASF (Anderson et al 2004) outlines the situation regarding karst management for each WA karst area. In summary, out of all the karst systems, there are a number of issues. Not all of the karst systems are protected with respect to their land tenure. In most situations, only portions of karst areas are contained in national parks. For example – Cape Range National Park (CRNP) and Yanchep National Park (YNP) only contain part of the local karst system. A large amount of karst is Crown land/rangelands/pastoral leases. Other karst systems are on private property. Out of the land that is under State Government control – there is no area with a current and up-to-date management plan. The management plans for the Leeuwin-Naturaliste National Park (LNNP), YNP, South Coast, and CRNP have all expired and are under review. It is important that the management plans take into consideration the karst system.

In addition, there is no policy that requires other land tenure types (with karst systems present) to have management plans or to conserve the natural environment. It seems to be that individuals with caves or karst systems on their private property can do what they like with the ecosystem. This is of concern, as not all significant caves or karst systems are protected appropriately.

The author would like to note that there is no karst area in WA that follows the IUCN principle of total catchment management, or Integrated Catchment Management (ICM). Only two karst areas have some form of regular speleological consultation – the YNP has the Caves Advisory Committee (CAC) while the LNNP has the Cave Management Advisory Committee (CMAC). Both of these advisory committees utilise volunteer speleologists and other community members for consultation on karst management issues. In some situations, the land manager may disagree with the 'advice' given by the committee and make a different decision – in this situation, there is little that can be done if the land manager is making decisions that may be detrimental to the karst system.

Only one karst area in WA has both a management plan with specific karst recommendations, and a manager with karst knowledge or experience. The LNNP has a 'caves manager' who is a speleologist who has obtained a postgraduate certificate in karst management. The management of this area includes regular speleological consultation through the use of the CMAC. This process is considered by the author to be working well. The WA Government needs to implement a similar system for the other major karst systems in WA.

Of particular concern are the karst areas under immediate threat. The caves of the Swan Coastal Plain (including YNP and LNNP) are under threat due to altered environmental conditions. In particular the water in the karst system has significantly decreased over the last 10 years (but also the last 20 years). There are several threatened communities and threatened species found in WA karst systems that may be protected under either State legislation or the EPBC Act. Such communities occur in YNP, LNNP and CRNP. For example there are the Remipede Community, Camerons Cave Community in the CRNP and the Threatened Ecological Communities of the Swan Coastal Plain.

Of particular concern is the effect of urban development (and the Perth metropolitan area) on caves and karst systems that are not contained in national parks. In particular areas of private property are being subdivided. There is a need for legislation and policy regarding planning and development in karst. Likewise, the land and water use in catchments for karst systems needs consideration.

It would be excellent if State Government agencies could work together to develop policy relating to karst systems and to have a specialist karst policy unit, a State Karst Officer or a Karst Education Officer. There is an opportunity for the Commonwealth to set some clear policy regarding karst systems. Also, there is a need for State Governments to acknowledge that managing karst systems requires some different skills and knowledge – due to the unique ecosystems involved. The development of an appropriate mix of policy instruments would be required. It would be excellent if there was a 'Cave Resources Protection Act' such as exists in the USA. It would also be excellent if government agencies could develop a range of other policy instruments in relation to the protection and conservation of caves and karst systems. Although this paper presents some recommendation, more specific detail is contained in the paper under development by the author (in press this volume).

RECOMMENDATIONS

- That the WA Government examine other countries' policy instruments relating to karst, as an example and to assist in the future development of policy documents.
- That the Government develop policy instruments to encourage private landowners to establish protected areas on their own properties, encourage landowners to undertake

conservation covenants or appropriately manage land containing karst systems.

- That there is a system of education regarding karst systems, particularly for the public and local government in karst areas.
- That the Government develop appropriate regulatory policy instruments to assist in the protection of the WA's cave and karst systems.
- That the Government implement appropriate policy instruments and that there are significant consequences for situations where policy instruments are not considered.
- That the WA Government implement a system for each major karst system in WA: where there is a current management plan, a karst manager and appropriate consultation with karst professionals and speleologists.
- That there is a "state karst officer" for Western Australia.

CONCLUSION

This protection and conservation of karst systems is a complex issue. There are a wide range of factors involved. This paper has examined the range of policy instruments that are available in relation to protection and conservation of all aspects of karst systems in Western Australia. The development of future policy can play a significant role in the protection and conservation of karst systems. It is excellent to see the progress that has been made, however there are opportunities for the development of further important policies in an integrated manner regarding this significant environmental issue. ■

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Appendix A

List of Federal, State, and local policy instruments

1. COMMONWEALTH

a. Legislation

- *Environmental Protection and Biodiversity Conservation Act 1999*

b. Broad Policy Documents

- Intergovernmental Agreement on the Environment – 1992 (IGAE)
- National Strategy for Ecologically Sustainable Development (ESD) - 1992
- National Strategy for Conservation of Australia's Biological Diversity - 1996
- Australian Heritage Commission Principles — ie the Natural Heritage Places Handbook and the Protecting Local Heritage Places document.
- The Burra Charter – The Australian ICOMOS charter for the conservation of places of cultural significance. I.C.O.M.O.S. Conservation Principles – 1988 & 1999
- Australian Natural Heritage Charter - Australian Heritage Commission
- The Richmond Communique: Principles and Guidelines for the Management of Australia's World Heritage Areas. Australian Committee for the IUCN.

2. STATE – W.A.

a. Legislation

- *Parks and Reserves Bylaws 1972*
- *Reserves Act*
- *Reserves and Road Closure Act Amendment Act 1978*
- *Town Planning and Development Act 1985*
- *Wildlife Conservation Act 1950*
- *Environmental Protection Act 1986*
- *Conservation and Land Management Act 2000*
- *Mining Act 1978*

b. Broad Policy Documents

- State Sustainability Strategy
- WAPC – SPP
- EPA – Draft Environmental protection (state groundwater) 1998
- EPA – Swan Coastal Lakes Policy
- DPI – Draft SPP 2.2 – Gnangara Groundwater Protection Policy
- Metropolitan Regional Scheme Amendment 1036/33 – Gnangara Mound Groundwater Protection

c. Specific Policy Documents Relating to karst systems

- EPA –Guidelines for Environment and Planning
- CALM – Policy on Tourism
- City of Wanneroo – Interim Local Rural Strategy
- EPA – No 54 – Sampling of subterranean fauna in groundwater and caves

d. Local and Regional Policy Documents

- LNNP – Permit system and CLAP (Cave Leader Accreditation Panel)
- Specific Regional Land Management Plans that involve karst areas (Yanchep NP, Cape Range NP, Nambung NP, LNNP NP etc)
- Report prepared for WA DEP – Hamilton-Smith et al 1998 – Cape Range.

Appendix B

Policy Instruments- Regulatory/Statutory relating to Environmental Protection & Conservation – in W.A.

1. National Parks and Nature Reserves – the land, flora and fauna.

Controlled and managed by the Department of Conservation and Land management (CALM) under the *Conservation and Land Management Act* and the *Wildlife Conservation Act.*

2. Heritage

The protection of natural and cultural heritage is dealt with by the *Heritage of Western Australia Act, National Trust of Australia (WA) Act* and the local town planning schemes.

3. Planning

This is chiefly governed by the *Town Planning and Development Act* and the *Western Australian Planning Commission Act.* These policy instruments set out procedures for making State, regional and local planning schemes and strategies.

4. Environmental Impact Assessment

Provision is made under the *Environmental Protection Act* for the environmental impact assessment of proposals that have the potential to have a significant effect on the environment.

5. Threatened Species

Native species of flora and fauna are protected under the *Wildlife Conservation Act* and managed by CALM under the control of the *Conservation and Land Management Act.* Flora that is on Crown land is protected under the *Land Administration Act.* Certain aquatic species and their environments are protected under the *Fish Resources Management Act.*

6. Soil and Land Conservation

This is covered by the *Soil and Land Conservation Act, Country Areas Water Supply Acts,* the *Environmental Protection Act* and the *Town Planning and Development Act.*

7. Water

A number of Acts cover water quality and usage. The *Rights in Water and Irrigation Act,* the *Metropolitan Water Supply, Sewerage and Drainage Act,* the *Waterways Conservation Act,* the *Environmental Protection Act.* Other relevant statutes include the *Soil and Land Conservation Act,* the *Country Areas Water Supply Act,* the *Health Act,* the *Land Administration Act* and the *Fish Resources Management Act.*

A. Wetlands, watercourses, surface waters and groundwater managed by the Water and Rivers Commission – now part of the Department of Environment, Water and Catchment Protection.