A BASIS FOR CAVE MANAGEMENT

GRAEME WORBOYS*
NSW National Parks and Wildlife Service

Abstract

As part of its charter to protect and conserve natural phenomena, the New South Wales National Parks and Wildlife Service has the responsibility of managing a number of cave areas. Because of the unique values of caves and the ever increasing demand on them for recreational usage, the Service proposes to implement a cave management plan which will provide a basis for protecting the caves under its control. This paper introduces a cave classification which will be used to categorise individual caves into management groupings. Five levels of cave management are recognised and the caves will then be managed according to these groupings.

Introduction

As part of its charter to protect and conserve natural phenomena, the New South Wales National Parks and Wildlife Service has the responsibility of managing a number of cave areas. Because of the unique values of caves and the ever increasing demand on them for recreational usage, the Service proposes to implement a cave management plan which will provide a basis for protecting caves under its control.

The two basic aims of the management plan are:-

(i) to establish appropriate protection for the spectrum of cave resources administered by the National Parks and Wildlife Service.

(ii) to establish a uniform approach to cave management throughout all Service-controlled areas.

To achieve these aims, the cave management study has:—

(i) determined the criteria to be used to document and evaluate (in terms of management) the importance of natural cave resources.

(ii) grouped the natural cave resources into management categories based on their relative scientific and recreational importance.

(iii) determined a cave classification which orders the management categories into a scheme which is applicable on a Service-wide basis.

The Cave Classification

The management of all Service-controlled caves will be according to the cave classification shown in Fig. 1. The classification is organised so that the most important cave resources are given the most protection. The scheme not only considers the individual cave but it also considers:—

(i) the cave in relation to the area surrounding it.

(ii) the importance of the cave and cavernous area relative to the rest of the park or reserve.

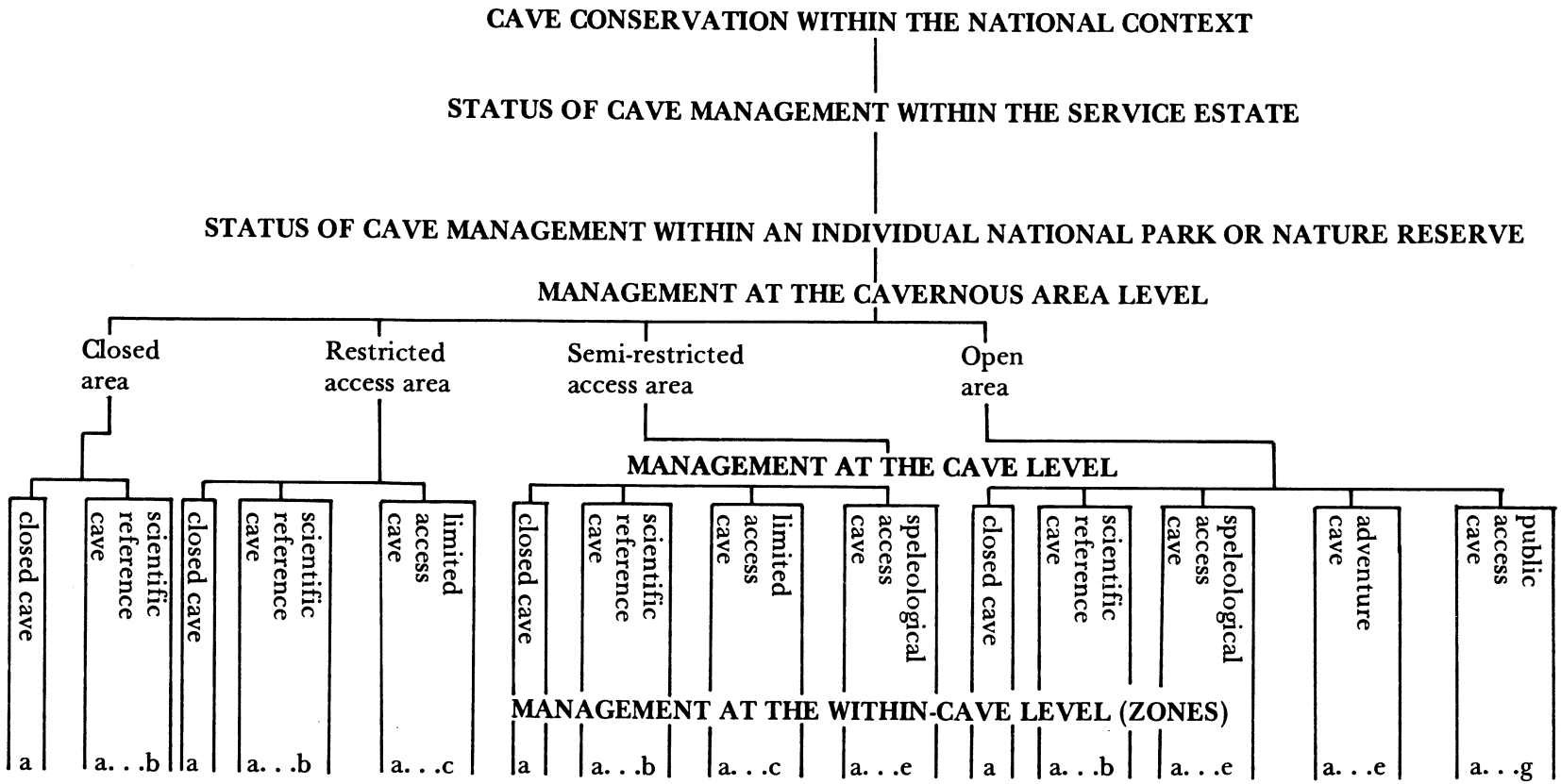
(iii) the importance of that cave and cavernous area relative to the state, national, and world-wide sphere of importance.

Similarly, the classification enables the appropriate management of individual chambers or sections within the cave.

The classification will also provide the basis for determining the adequate sampling of the Service-controlled cave resource, since documentation of the cave resources at the Service estate level will enable the comparison of the conservation area's resources against the state's cave resources. This aspect is especially important in relation to maintenance of cave biological resources, in particular, bats. Access and permit systems will also be determined relative to the cave classification.

* Box N189 Grosvenor Street PO, Sydney, NSW 2000

Fig. 1. The Cave Classification.



Key to zones: a — closed; b — scientific reference; c — limited access; d — natural passages; e — partially developed passage, no electric lighting; f — developed passage, with electric lighting; g — intensive use area.

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The cave classification recognises five levels of cave management:–

A. the Service estate level

B. the individual national park or nature reserve level

C. the cavernous area level

D. the cave level

E. the within-cave level

Generality increases from the detailed within-cave classification to the Service estate level, which assesses the status of cave protection on a New South Wales, nationwide, or world wide basis.

The classification works on the following basis (for a typical national park):–

(i) Cave areas within the park are recognised.

(ii) All of the available resource information on the area is collated and the importance of each area is determined at the Service estate level.

(iii) This decision immediately determines the management of all the caves within the individual area since it determines access. If, for example, a cavernous area is extremely small but scientifically important, management would consider it as a restricted access area (or a more stringent classification). As shown in Fig. 1, this classification only considers access to speleologists who are experienced, or those that enter the area on a scientific permit basis.

Thus a management decision at the cavernous area level immediately imparts the minimum qualification required by persons entering the area. However, the cavernous area classification still retains the flexibility for management to impose even greater access restrictions to individual caves above that minimum level. This is particularly important at the open area classification, where scientifically important caves might be individually recognised, or reference caves might be established in an area that might otherwise have a recreational emphasis.

(iv) The caves are classified according to their individual importance and the minimum standard predetermined by the cavernous area classification.

(v) Where necessary, individual chambers within a cave are classified according to the minimum standard established by the cave's classification. This within-cave management level may be particularly important for the protection of bat breeding chambers in a large cave system or for retaining "reference sections" of cave in public access caves.

The cave classification thus overcomes the major problem of surface management classifications that have been used to protect cave areas in the past. That is, it accounts for the variability and individuality of caves within a cavernous area, and manages the individual cave according to its inherent values. The details of the individual levels of the cave classification are outlined below:–

A. The Service estate level

Controlled at head office, the Service estate level represents the master planning, co-ordinating, and controlling level of the cave management plan. Service-administered cave resources will be managed on a state-wide basis to obtain the ultimate balance of preservation, conservation, and recreation, relative to the importance of the resources and the degree of protection afforded to other cavernous areas. The adequacy of the Service's present sampling of cavernous areas will be assessed. A single permit system will be controlled at the Service estate level, although access to individual caves will be controlled at the park level.

B. The national park or nature reserve level

The national park or nature reserve level of management considers the management of cavernous areas in relation to their geographical position within the park or nature reserve, the significance (physical and biological) of the areas, the external influences and resource pressures on the areas, and historical influences. The minimum level of management, however, will be somewhat determined by the policies of the Service estate level. Management emphasis will be placed on the "greatest protection of the most important cave resource", and will therefore require an evaluation of the resources of the cavernous areas. Specific considerations have been documented as guidlines, and are presented below:–

Criteria used to evaluate the importance of the cave resource at the national park or nature reserve level.

(i) Geological considerations

Rock type, structure, stratigraphic relationships, palaeontological rarities, minerals present etc., may make a cavernous area unusual or unique. For example, caves are generally associated with limestone, but may also be associated with lava flows, evaporite deposits, dolomite, sandstones and other rock types, and may as a result be unusual.

(ii) Geomorphological considerations

Surface and sub-surface landforms in a karst area are often the most important features for management to consider. Underground features such as extensive caverns, unusual phreatic or vadose passageways, and extensive speleothem displays; or surface features such as cliffs, gorges, large cave entrances, natural arches, dolines, uvalas, minor solution features (flutes, grikes, funnels), blind valleys, semi-blind valleys; and so on, may make an area geomorphologically important.

(iii) Hydrological considerations

Surface drainage patterns and sub-surface drainage patterns may determine the significance of an area. For example, the sinking or rising of streams and their underground movements may be unusual. Large underground lakes and waterfalls may be present as might natural or thermal springs, thus making the area important.

(iv) Biological considerations

Hamilton-Smith (1971) presented a seven-category system for the classification of cavernicolous fauna:–

(a)	Parasites	– obligate parasites
(b)	Accidental	– not regularly inhabiting caves
(c)	Threshold	– inhabit twilight zone
(d)	Trogloxene	– does not complete its life cycle in cave
(e)	1st level Troglophile	– known from epigean and hypogean habitats
(f)	2nd level Troglophile	– known only from caves, but not exhibiting any modifications to the cave environment
(g)	Troglobite	– living total life cycle within caves and modified to the cave environment

The classification is an indication of the diversity of cave fauna. Cave flora is generally restricted to the entrance and threshold zones of the cave; ferns, algae, mosses and liverworts being the dominant groups.

Thus a cavernous area may be biologically significant where it supports unique, rare, or unusual life forms. It may also be significant as one of the few bat breeding areas in the state. Specific examples of unique areas in the biological sense may also include those that maintain relict fauna or flora. In nearly all cases where cavernous areas are biologically diverse, they should be considered as important.

(v) Meteorological considerations

Some cave areas may lend themselves, as a result of their morphology and geographical setting to unusual conditions of air movements, temperature, humidity, and air composition. These meteorological effects may be sufficiently important to warrant special protection measures.

(vi) Archaeological, fossil, and sub-fossil considerations

Anthropogenic influences, the presence of fossil fauna and flora, and presence of deposits or accumulations of sub-fossils (bone deposits), may make a particular cavernous area significant.

(vii) Historical influences

Past access, cave development, vandalism, usage patterns, etc., may have altered or affected the values of a cave area. The present management of an area may be dictated by these influences.

(viii) Geographical setting

The location of a cavernous area may assist in the management of a cave resource just as it may increase the problems of management of an area. Physiographically isolated cavernous areas with natural or easily imposed access restraints will be afforded protection because of natural limitations on their use. Only the keener, and generally conservation-orientated, speleologists would be interested in venturing to such isolated localities. Conversely, many significant cavernous areas are located in areas of easy access and topographical settings which make management difficult. Generally these areas are either prone to abuse by a wide spectrum of users, or have already been affected by such users. Similarly, cavernous areas located close to large areas of population may be affected by heavy visitation pressures. Thus, in assessing the importance of an area, management must also consider the influences of the geographical setting and the visitation pressures for its effective protection. The recreational importance of the cavernous area must also be considered.

C. Cavernous area level

A decision made at the national park or nature reserve level will impose one of the following management classifications over all or part of the cavernous area :–

(i) Closed cavernous area

(ii) Restricted-access cavernous area

(iii) Semi-restricted-access cavernous area

(iv) Open cavernous area

Management at the cavernous area level reflects the degree of importance of the caves, landforms, and other natural features found within the cavernous area. It represents a surface planning concept that directly controls sub-surface (cave) access. Thus surface management aspects such as the protection of landforms, vegetation communities, and stream catchments are important considerations at this level. The sub-surface (cave) minimum access requirements are defined by the cavernous area classification. (However, individual caves may have more restrictive access controls within that area). Two or more classifications may be required over any one cavernous area. That is, there may be a need to divide the management of a cavernous area into sub-areas into which influences such as development, visitation access points, and general recreation areas, are considered along with the protection of the resource. The classifications defined above would be used to define the sub-areas. (For example, Yarrangobilly Caves within the Kosciusko National Park could be defined as partly an open, and partly a restricted-access, cavernous area because of the development area at the southern end of the limestone and the natural caves to the north of the development area). The areal extent of the management sub-areas within a cavernous area must be precisely defined. Details of the four cavernous area classifications are presented below.

(i) Closed cavernous area

An important bat maternity site or breeding colony would be sufficient justification for managing an area as a closed cavernous area. Similarly, a closed cavernous area may be important scientific reference area, or the site of scientific studies which may warrant its management classification. Two types of cave classifications are envisaged for the area and include closed caves and scientific reference caves. Access to the area would be subject to a scientific permit being granted by the Director.

(ii) Restricted-access cavernous area

Where a cavernous area is considered, by the nature of its inherent values and resources, to be significant for special management protection, then access to it may be designated as "restricted". Three types of caves may be found in the area, and include closed caves, scientific reference caves, and restricted-access caves. The minimum access restrictions to the area are determined by access to the restricted access caves. Such areas would include all cavernous areas within the Service estate deemed as being "significant for the preservation and protection of the cave resource".

(iii) Semi-restricted-access cavernous area

A cave area is defined as a semi-restricted-access area when the nature of the area's physical and/or

biological attributes does not warrant special protection as a closed cavernous area or a restricted-access cavernous area. Geographical and sociological pressures may influence the designation of an area as a semi-restricted-access cavernous area. The minimum access requirement is as indicated by the requirements of the speleological access cave. Four types of "management caves" may be found in the area. These include the closed cave, scientific reference cave, the limited-access cave, and the speleological access cave.

(iv) Open cavernous area

All cavernous areas that are either of little scientific value or have, because of historical factors, been altered or developed in such a manner as to have lowered their scientific values; or those cavernous areas that have been opened to general visitor access; are defined as open cavernous areas. Six types of caves may be found in an open cavernous area; that is, closed caves, scientific reference caves, limited-access caves, speleological access caves, adventure caves, and public access caves. This allows for the preservation and protection of important caves in a development area.

D. The cave level

As for the cavernous area level the cave level classifications are based on restriction of access. Six cave classifications are envisaged and are documented below:–

(i) Group 1 – closed caves

Closed caves are those caves in which access is not permitted. They may be caves that are dangerous (e.g: bad air or unstable caves), or caves that are awaiting further classification. The principal management aims are to protect caves from speleological visitation pressures while they are awaiting classification, and to close access to dangerous caves. Access will only be granted to experienced cavers undertaking a Service-approved cave classification study.

(ii) Group 2 – scientific reference caves

Scientific reference caves are defined as caves that are best representative of geomorphological, geological, biological, and/or speleothem attributes of the caves in the area. Preference for this classification will be given to those caves in which man's disturbance has been minimal, and where the physical qualities of the cave and its biological content are essentially in a natural condition. The principle management aim is to preserve the caves in their natural state so that a reference set of caves and cave life are available for the future. A gate is a necessary prerequisite for the establishment of a scientific reference cave. Access to these caves will be strictly controlled and restricted to detailed research work only. Entry will only be granted to experienced cavers on the basis of the standard scientific permit. The scientific permit will indicate the nature and value of the detailed research work and the possibility of any physical disturbance to the cave. If inexperienced cavers are to be granted a permit they must demonstrate that they have the qualifications and ability to undertake the research work and they must be accompanied by a team of experienced cavers. At all times, parties entering scientific reference caves will be under the leadership and deputy leadership of experienced cavers who will be responsible for the safety of the party and the protection of the cave. A maximum and minimum number within the cave at any one time will be designated according to the cave's characteristics.

(iii) Group 3 – limited-access caves

Those caves which have such a quality in their physical and/or biological attributes that they warrant special protection, even though these attributes are already represented in scientific reference caves in the area, or for safety reasons, those caves which have a degree of difficulty which limits cave exploration to experienced cavers only, shall be classified as limited-access caves. The principal management aims are to preserve the high quality of limited-access caves and/or to maintain a high safety standard. Access to these caves will be restricted to experienced cavers only, and a maximum number within the cave shall be designated according to the individual cave's characteristics. The installation of a gate is a necessary requirement where the physical nature of the cave permits. Where necessary to minimise damage to a particular cave the frequency of visits may be restricted. Detailed speleological research is to be encouraged.

(iv) Group 4 – speleological access cave

A speleological access cave is defined as a cave where the nature of the cave's physical and/or biological attributes does not warrant special protection as a scientific reference cave or a limited-access cave and where the degree of difficulty is suitable for cavers and novices. The speleological access caves also include those caves not suitable as adventure caves or public access caves, and those which may be suitable as training caves. The principal management aim is to maintain the cave's natural features and to provide the appropriate exploration opportunities for cavers. The installation of a gate is an essential requirement where the physical nature of the cave permits. Access will be granted to cavers in the speleological access caves provided that the group has an experienced leader and deputy and that the ratio of experienced cavers to cavers ideally does not exceed 1 :3. The number of cavers within a cave at any one time will be restricted according to the nature of an individual cave. The individuality of the cave may also lower the ratio of experienced cavers to cavers. Novices will be restricted to 25 per cent of the total number of the party.

(v) Group 5 – adventure caves

An adventure cave is defined as a cave that has little or no inherent value other than its morphological form, and which would be suitable for exploration by inexperienced but properly equipped parties, such as organised youth groups. The principal management aim is to permit cave exploration by non-speleological groups in caves where the degree of difficulty and the potential damage factors are low. The installation of a gate is recommended where the physical nature of the cave permits.

(vi) Group 6 – public access cave

For the purposes of this study, public access caves include those caves in open areas that have been developed or are suitable for development as public inspection caves. Public access is with a ranger unless the cave is especially designed otherwise. No special equipment or clothing is required unless specified by the ranger.

Cave description checklist

To assist with the evaluation of the natural values of individual caves, a checklist of important aspects to be considered has been prepared. The checklist also includes topics that will assist management to estimate carrying capacities and frequency of visits to the caves.

Location and external relationships
History of the cave
Cave map, preferably of standard better than CRG 4D
Geology
Morphology
Mineralogy
Hydrology
Biology
Meteorology
Sub-fossils (bones)
Archaeology
Other special features
Vandalism
Potential gate site – environmental impact of gating
Maximum and minimum limit to the number of cavers for the cave
If a group 4 cave, the ratio of experienced to inexperienced cavers for the cave
Minimum amount of user equipment needed for the cave
Recommended frequency of visits to the cave

E. The within-cave level

The within-cave level of management recognises the need to manage the resources of the particular cave. It provides the basis for the recognition and effective management of extensive and variable cave chambers and passageways within the cave. For example, bat breeding chambers, sections of a

cave that exhibit rare and delicate speleothems, or chambers that are archaeologically or palaeontologically significant. By zoning parts of caves according to this concept, it may be possible to allow recreation and/or exploration activities within the greater part of the cave whilst protecting the remainder as a reference section. Similarly, public access may only be permitted for part of the cave, the remainder of which may be managed according to the within-cave management plan.

The within-cave classification will be related to a detailed evaluation of the resources of an individual cave, and a cave map of standard not less than CRG 4D will be required to compile the management plan. For this reason, the Service will rely heavily on the assistance of concerned and expert speleological groups for the compilation of effective management proposals for individual caves. A within-cave classification prepared for the management of the Mammoth Cave system by the United States National Parks Service has been adopted as the basis for the within-cave classification used here; zones are designated by the letters "A" through "G" in order of use and development.

(i) Zone A – closed passages

These passages may be closed by gate for either safety or scientific reasons.

(ii) Zone B – scientific reference

The scientific reference zone relates to a part of a cave which may be an excellent representative of the geomorphological, geological, biological and/or speleothem attributes of the cave or caves in the area. It may be used as a measure of the effect of variable visitor usage on the remainder of the cave, or it may protect important biological sites, etc. Whenever possible, zone B passages will be closed to access from the rest of the cave by a gate, and access will be granted on the basis of a scientific permit.

(iii) Zone C – limited-access

The limited-access zone of a cave relates to passages or chambers whose physical and/or biological attributes warrant special protection, and/or those passages which have a degree of difficulty which limits exploration to experienced cavers only. Where possible, access to the limited-access zone will be restricted to experienced cavers by the use of a strategically placed gate.

(iv) Zone D – natural passage

Only those speleologists properly equipped and experienced in caving techniques may traverse those passages which have not been improved in any way. Access along natural passageways will be as for speleological access caves.

(v) Zone E – partially developed passage (no electric lighting)

This zone relates to those passages which are partially developed or were once developed and are now abandoned. Trails range from good to somewhat primitive. Other development is limited to that essential for visitor safety, and as there is no electric lighting, such passages provide a "wild" cave experience for visitors without training in caving techniques. Lighting is by hand-held lanterns.

(vi) Zone F – fully developed passage (electrically lit)

This zone includes all those passages provided with electric lighting aesthetically arranged and developed with trails, bridges, steps, stairways, landmarks, etc. Except where otherwise stated, (e.g.: the self-guiding cave, Glory Hole, Yarrangobilly) guides accompany all parties and a fee is charged – parties will not exceed the "limit" placed on the individual cave, and the frequency of visits will also be dependent on the management of the individual cave.

(vii) Zone G – intensive use area

Limited to those areas where people assemble; a concept more specifically orientated to Mammoth Cave (U.S.) where underground lifts and visitor facilities are provided, and as indicated by the text, "such places, essential to the comfort and convenience of the visitor, are located in sections of cave passages which have low aesthetic and/or scientific value". It is not envisaged that many such zones will be designated in New South Wales caves.

Conclusion

A cave management plan using an approach based on a "recognition and evaluation of the scientific and recreational importance of the cave resource" has been prepared as the basis for the effective and systematic management of caves within areas controlled by the National Parks and Wildlife Service.

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Reference

HAMILTON SMITH, E. (1971) The classification of cavernicoles, *Bull Nat. Speleol. Soc., 33* (1).

APPENDIX: Terms used in the classification

A. Experienced caver

An experienced caver is one who can satisfactorily demonstrate that he/she has achieved the standard of caving proficiency defined by the list below, or is a caver who can demonstrate that he/she has reached an equivalent standard.

(i) He/she shall have the necessary temperament and sense of responsibility to ensure the safety of the party, the protection of the cavern, and the well-being of the society.

(ii) He/she shall have attended ten or more official caving trips.

(iii) He/she shall be proficient in the following:–

Knots – bowline, clove hitch, prussik
Belaying – preparation and care in the use of a safety rope and holding 75 kg in a simulated fall.
Abseiling – from an overhang of 10–20 m with or without a karabiner.
Coiling and care of ropes and wire ladders.
Ladder climbing techniques.
Prussik slings – their use in the ascent of a single rope.

(iv) He/she shall have taken part in lectures and discussions or should otherwise prove that he/she is familiar with topics such as:–

(a) safety in caves
(b) surveying and mapping techniques
(c) basic first aid
(d) trip organisation

B. Caver

A caver is one whom the experienced caver considers to have the necessary sense of responsibility to ensure the protection of the caverns; who has had training in cave safety and caving techniques, but who has not yet achieved the standard of experienced caver. He/she will, upon entering a National Parks and Wildlife Service controlled cave, have the minimum amount of equipment consistent with personal safety and adequate protection of the cave.

(i) *Personal equipment*

All persons entering caves must have a minimum amount of personal equipment which includes:–

(a) helmet – suitable approved lightweight miner's-type helmet – pudding basins and similar substitutes will not be allowed.

(b) three independent sources of light – e.g: caplight, hand torch, and candle. Carbide is permitted, only on the condition that the spent carbide is removed completely from the limestone area and placed in a suitable depository (e.g: a garbage bin).

(c) overalls in preference to normal old clothes

(d) suitable footwear without nails.

(e) waistloop or equivalent

(ii) *Group equipment*

The group equipment is the responsibility of the leader. Ideally each cave will have listed with the classification the minimum equipment needed for its safe exploration.

C. Novice Caver

A novice caver is one who has no previous caving experience; or has not, in the opinion of the experienced caver, had sufficient caving experience to be familiar with the basics of cave safety and caving techniques.

D. Cavernous area

For the purpose of this paper, a cavernous area is defined as the actual area (defined on the surface) that contains caves. The limits of the cavernous area are defined by the extent of the surface and sub-surface expressions of the caves. (For limestone karst areas, the extent of the limestone may be defined as the cavernous area).