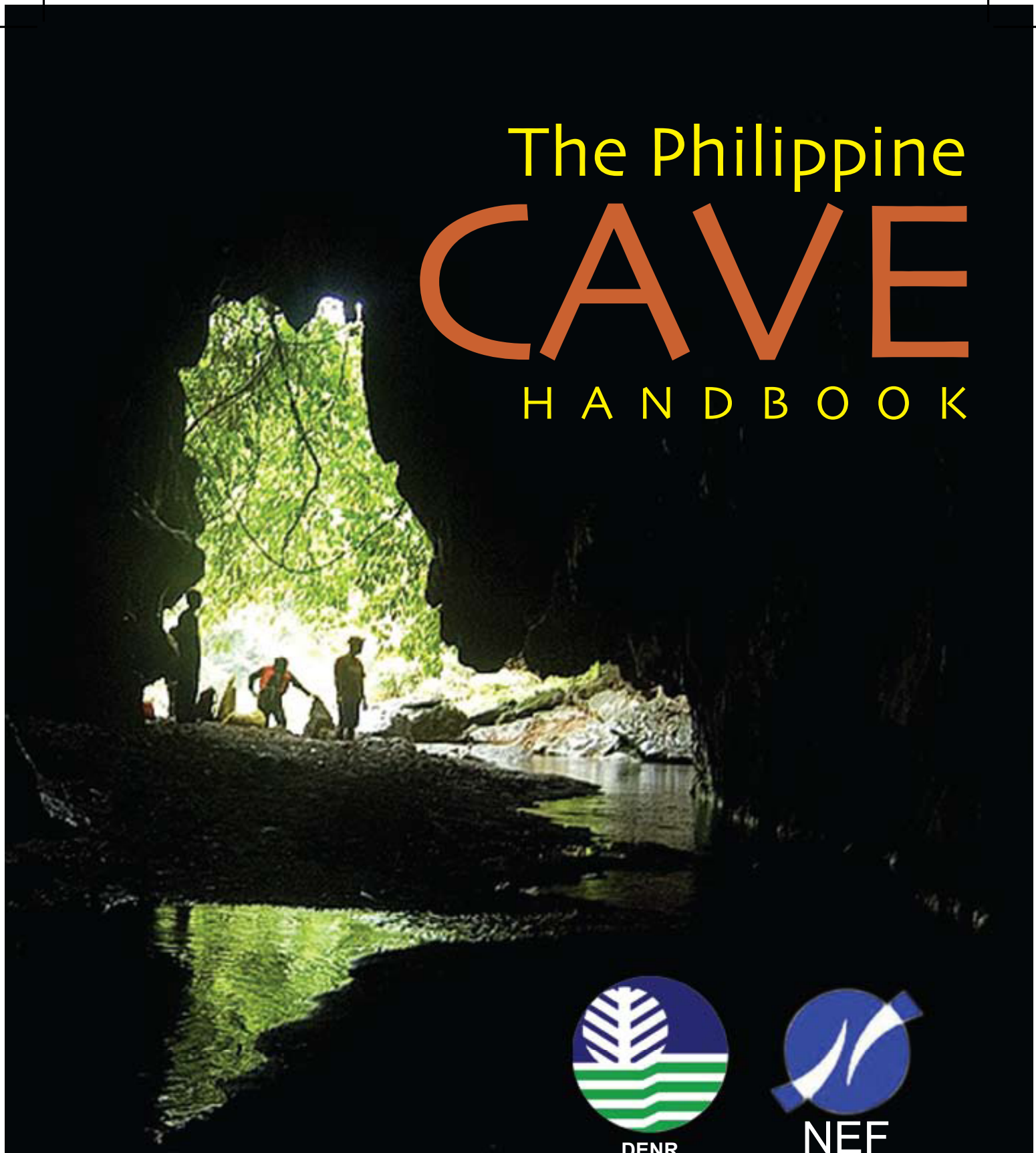
The Philippine CAVE HANDBOOK



DENR
Protected Areas
& Wildlife Bureau

NEF

Otso Cave
Photography by Roderic C. Parcon with the Davao Speleological & Conservation Society (DSpeCS)

The Philippine CAVE HANDBOOK

Guidelines & Manual for
CAVE CLASSIFICATION
in the Philippines

Prepared by:
Protected Areas and Wildlife Bureau
Department of Environment and
Natural Resources
Republic of the Philippines
2009

The production of this Handbook was made possible through the financial assistance given by the Nagao Natural Environment Foundation (NEF) of Japan, 2009

table of contents

DENR-PAWB
Ninoy Aquino Parks and Wildlife Center Compound
Quezon Avenue, Diliman
1101 Quezon City, Philippines
Tel. (+632) 924-6031
Fax. (+632) 925-0109; (+632) 925-8950
planning@pawb.gov.ph
http://www.pawb.gov.ph

ISBN 978-971-8986-77-6

For citation purposes, this document may be cited as:
Department of Environment and Natural Resources-
Protected Areas and Wildlife Bureau, 2009
Cave Classification Handbook. Quezon City, Philippines, 62 pp.

preface

This Philippine Cave Handbook, initiated by the Protected Areas and Wildlife Bureau of the Department of Environment and Natural Resources (PAWB-DENR), is the result of cooperation and support from concerned government agencies, local government units, the academe, and non-government organizations.

After various efforts in formulating and proposing programs, laws, and policies on Cave Management, the Handbook team has come out with a versatile, handy, and very useful reference for everyone in need of information about caves. The Handbook serves as a ready reference on basics about caves, their management, protection, and classification.

The Handbook also aims to impart to cavers and every other individual the value of caves and the wildlife fauna found therein. Part 1 discusses cave consevation and management while Part 2 presents the DAO 2007-02 or Guidelines for Cave Classification. Other important considerations in classifying caves are provided in Part 3. Also included are annexes on other pertinent information about caves that are deemed necessary for cavers and as well as the general public.

Special thanks are due to Philip Alviola, Danilo Balete, Arvin Diesmos, and Dr. Tomoki Kase for their study used as reference for this Handbook, and for the photos from Gaia Exploration Club (GEC).

foreword

Caves are one of the wonders of the natural world. Usually hidden among mountains, inside them are awesome cathedrals of stone. Caves are formed slowly over eons. Water and the earth's minerals seep through cracks and crevices, into the bowels of mountains or underground, and over the centuries the sediments form pillars and ceilings of stone—calcite and crystalline caverns of stalactites and stalagmites that show off a fascinating natural architecture. And within the passages and hallways of these caves diverse flora and fauna find a home.

What nature has built over thousands of years, which became the home of thousands of species of living creatures, cannot be destroyed overnight by neglect, ignorance, or vandalism. That's why caves have to be protected—by people, their governments and laws. A lot of caves in the Philippines have been vandalized by careless visitors and damaged by poorly planned commercial development. Such destruction is a crime against nature and there is a moral responsibility on the part of everyone to ensure the preservation of caves for other people to enjoy and for future generations. As many people as possible must be involved in preventing the destruction of these natural wonders.

Republic Act 9072, dated April 08, 2001, is the Philippine law for the protection of caves. Otherwise known as the National Cave and Cave Resources Management and Protection Act, RA 9072 mandated the Department of Environment and Natural Resources (DENR) to formulate, develop, and implement a national program for the management, protection, and conservation of caves and cave resources. In pursuit of this mandate, the Protected Areas and Wildlife Bureau (PAWB) publishes this Handbook on Cave Classification for the Philippines (the Philippine Cave Handbook), with the end in view of providing necessary information that can guide field offices in the development of specific cave management and conservation programs.

THERESA MUNDITA S. LIM
Director
Protected Areas & Wildlife Bureau

message

From the Gaia Exploration Club-Subterra

We are proud to be part of the development of the Guidelines for Cave Classification and the Handbook on Cave Classification of the Philippines. The process took a lot of twists and turns but in the end we have to come out with a comprehensive reference to inform and guide people involved in cave classification. We hope that this handbook helps in making the task of cave assessment and classification clearer and easier and the results reflecting the true values of the classified caves.

In using our caves and cave resources, we believe that cave classification is the first step in ensuring that the Philippine cave systems are protected from destruction and ultimately should be the starting point for proper cave management. Thus, we recommend that this first step be given a priority. This takes training and equipping the caves assessment teams with skills and necessary gear and resources to do the job effectively. It is only when the teams are out there and inside the caves that the full usefulness of this handbook will be attained.

And as cavers, we are aware of the risks people are taking in participating in cave assessment as well as their impact on the caves being assessed. Remember to cave softly and safely.

Mark P. Q. Dia
President, GEC

part one

Caves and Nature Conservation

Over 1,500 caves have been recorded by the Department of Environment and Natural Resources (DENR) since the implementation of the Caves Management and Conservation Program (CMCP) in 1994, with still a significant number yet to be discovered and mapped.

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

These caves are considered unique, natural, and non-renewable resources with important scientific, economic, educational, cultural, historical, and aesthetic values. They are also home to specialized mineral formations with unique and diverse flora and fauna.

However, despite their diversity and significance, most of the country's caves are in peril due to several reasons: the lack of specific statutory protection, increased demand for recreational sites, treasure hunting, mining, pollution, illegal collection of cave resources, and rapid urbanization. Caves are part of the country's natural, historical, and cultural heritage, and their destruction forever obliterates this part of a country's nationhood. At the same time, the generation that is unable to protect them denies the present as much as the future generations the chance to enjoy them.

Some of the famous Philippine caves and cave systems are the Puerto Princesa Subterranean River National Park in Palawan, which has a spectacular limestone karst landscape and has been included in the World Heritage List. Another example is the Tabon Caves Complex where human remains recovered date to 47,000 years ago.

Caves are very crucial for the conservation of biodiversity. They provide habitat to some of the country's threatened animals which are yet to be protected by the existing network of protected areas. According to a study of Alviola, three biogeographic regions of the country account for 97% of caves recorded by the DENR-PAWB in its implementation of the CMCP (Alviola, unpublished).

The percentage of caves recorded in the Philippines are as follows: Luzon (38%), Mindanao (37%), and Negros-Panay (22 %). These are presented in Figure 1.

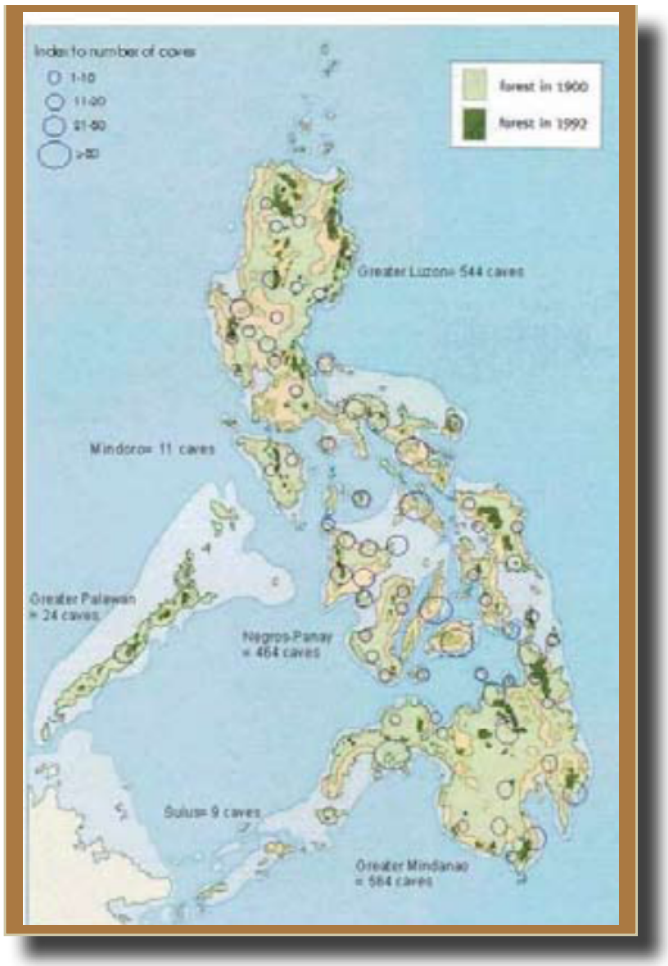


Figure 1. Cave distribution in the Philippines (adopted from Alviola)

Seven caves are with protected area status representing less than one percent while there are around 300 caves initially assessed for cave management plan preparation.

Alviola also cited the following statistics relative to the diversity, distribution, and endemism of cave fauna:

- A total of 44 species have been recorded: 34 bats, 5 reptiles, 3 birds, and 5 frogs;
- Forty-five percent of the bat fauna in the country are cave-dwellers;
- Bats found in caves also represent 20% of the currently known species of Philippine mammals;
- Endemism is remarkably high, with at least 23 species found only in the country and nowhere else.

Seven species of frogs found in Philippine caves are *Platymantis insulatus,* (Brown, W.C. and Alcala, A.C., 1970; Brown, R.M. and Alcala, A.C., 2000); *Rhacophorus leucomystax quadrilineatus and Platymantis paengi* (Siler, C.D. et. al, 2007); *Platymantis guentheri, Platymantis bayani, Platymantis diesmosi, and Platymantis spelaeus* (Siler, C.D. et. al, 2009).

Gekko ernstkelleri

Platymantis paengi

Photos from C. D. Siler

Species of reptiles found in caves include *Gekko gigante* and *Gekko ernstkelleri* (Rosler, H., et al., 2006).

Meanwhile, a new troglobithic species of the freshwater crab genus *Sundathelphusa (Parathelphusidae)*, *S. waray* and *S. lobo* are described from two caves in Samar, Philippines. Thus, to record, there are already nine species of caverniculous species of *Sundathelphusa* in the Philippines. This new species is characterized by non-pigmented body, greatly reduced eyes and long ambulatory legs which are associated with previously known troglobithic crabs (Husana, et. al, 2009).

The synopsis of the Mammalian Fauna of the Philippine Islands (1998) published by the Fieldiana Museum provides that "the Negros bare-backed fruit bat, *Dobsonia chapmani,* was believed to have been extinct in the 1970's due to the combination of forest destruction, disturbance by guano collectors, and hunting. However, a living population has been discovered in Cebu and on Negros." It is still considered as critically endangered under the DENR Administrative Order No. 2004-15 or List of Terrestrial Threatened Species.

The Dayak fruitbat, *Dyacopterus rickarti,* is also considered near-threatened under the World Conservation Union's Red list. Another indicator that "all is not well" as far as cave fauna is concerned is the critical conservation status of two endemic cave dwelling frogs:

- *Platymantis spelaea,* Negros limestone frog
- *Platymantis insulate,* Gigantes Islands limestone frog

Meanwhile, *Platymantis insulate,* commonly known as the Gigantes Islands limestone frog, is categorized as a vulnerable species under DAO 2004-15 or the List of Terrestrial Threatened Species.

During a joint field investigation with DENR-PAWB staff on February 2003 on anchialine caves in Panglao Island, Bohol, Dr. Tomoki Kase (Department of Geology and Paleontology, National Museum of Nature and Science, Tokyo), expressed disappointment over the disappearance of small crustaceans like crabs and shrimps inhabiting the caves in the area. This is brought about by the uncontrolled introduction of facilities and cave modification to

accommodate tourism. When bats are disturbed, they abandon the caves and this halts their production of guano resulting in nutrient loss or loss of food for small crustaceans.

Management of caves is very much dependent on baseline faunal and ecological surveys which classify and prioritize caves for management and protection. It is also important in determining the conservation status of cave life and in monitoring ecological factors to better understand the changes in cave fauna.

Ecosystem management is the key in cave conservation. The ultimate survival of cave community depends on the proper protection and management of the cave and its surrounding terrain. It is very important to maintain the native vegetation surrounding the caves and ensure their watershed functions. Cave conservation pertains to preserving and protecting the vital ecological

part two

DENR Memorandum Circular
2007-04

SUBJECT : **PROCEDURE IN CAVE CLASSIFICATION**

Pursuant to Republic Act No. 9072, otherwise known as the National Caves and Cave Resources Management and Protection Act of 2001, and Sections 10, 12 and 13 of its Implementing Rules and Protection Act of 2001, (DAO 2003-29), a Manual on Cave Classification is hereby prescribed and adopted for all caves within the public domain and private lands, including those found within protected areas for the guidance of all concerned.

Section 1. **Process in Cave Classification.** The following are the general steps in cave classification.

1. Identification of caves, including their location and general description through available topographic, cave maps, and field reconnaissance surveys;
2. Assessment of bio-physical, socio-economic and cultural status of identified caves;
3. Recommendation of classification by the cave assessment team;
4. Review of recommended classification by the Regional Cave Management Committee (RCMC) or the Protected Area Management Board (PAMB), in the case of protected areas; and
5. Approval of classification by the Regional Executive Director (RED).

Section 2. **Cave Assessment Team**

A Cave assessment team shall be created in each CENRO by the Regional Executive Director to be composed of the following disciplines: biology, geology, socio-economics, and other relevant fields of expertise. The team shall include representatives from the other sectors concerned.

Section 3. **Cave Classification**

The Caves, after assessment, may be classified as follows:

Class I. Caves with delicate and fragile geological formations, threatened species, archeological and paleontological values, and extremely hazardous conditions. Allowable use may include mapping, photography, educational, and scientific purposes.

Class II. Caves with areas or portions which have sections that have hazardous conditions and contain sensitive geological, biological, archeological, cultural, historical, and biological values or high-quality ecosystem. It may be necessary to close sections of these caves seasonally or permanently. It is open only to experienced cavers or guided educational tours/visits.

Class III. Caves generally safe to inexperienced visitors with no known threatened species, archeological, geological, natural history, cultural, and historical values. These caves may also be utilized for economic purposes such as guano extraction and edible birds nest collection.

Section 4. **Annual List of classified caves.**

All Regions are required to submit to PAWB their list of classified caves. PAWB shall consolidate and prepare the list of classified caves. DENR shall publish a consolidated list of classified caves annually.

Section 5. **Transitory provisions.**

Caves with existing utilization permits such as guano and edible bird's nest, (except water rights permit), ecotourism, and research and development activities , may be temporarily suspended, canceled or terminated, when a cave is recommended for temporary closure, after consultation with local government units (LGUs) and concerned parties.

Section 6. **Repealing Clause.**

All circulars and memoranda which are inconsistent herewith are hereby revoked or amended accordingly.

Section 7. **Effectivity**

This circular takes effect immediately.

(SGD.) **ANGELO T. REYES**
Secretary

Manual on Cave Classification

I. What is Cave Classification?

Cave Classification pertains to the entire process of assessing and determining appropriate sustainable use of caves with due consideration to:

1.) biodiversity,
2.) archaeological,
3.) historical,
4.) cultural, and
5.) potential socio-economic values.

This Manual is intended to serve as a guide for DENR field implementers, cave coordinating agencies, and other concerned sectors in classifying caves in the country.

II. Why conduct cave classification?

- To ascertain the values of caves in terms of ecological, archaeological, historical, cultural, and other socio-economic values.

- To identify the appropriate sustainable use of caves with due consideration to the aforementioned values.

- To determine the appropriate management strategies for the conservation and utilization of caves in relation to identified values, surrounding karst and limestone areas, and other local and global initiatives for cave research, management, and protection.

III. What are the procedures for cave classification?

Cave classification entails the following major steps:

Cave Identification – Existing or known caves must be identified. Identified caves shall be supported by providing information such as the local name (if available), general description (elevation, accessibility, etc.) and location using topographic maps and available cave maps which conform to the British Caving Research Association (BCRA) minimum standard of grade 3C (see Annex A).

All DENR field offices are responsible for identifying caves within their administrative jurisdiction.

Cave Assessment – All identified caves must undergo assessment process using the Cave Assessment Form (see Annex B). Cave assessment is a comprehensive data gathering and inventory of cave resources that shall be accomplished at the site level.

A cave assessment team shall be created by the Regional Executive Director (RED) in each Community Environment and Natural Resources Office (CENRO) to be composed of the following disciplines: biology, geology, socio-economics, and other relevant fields of expertise. The team shall include representatives from the other sectors concerned. The main qualification for members who will constitute the assessment team includes previous training on cave assessment. The Protected Area Superintendent (PASu) shall automatically be part of the team if the cave is within a protected area. The representatives of the cave coordinating agencies including the National Museum, National Historical Institute, Department of Tourism, and accredited caving organizations and stakeholders concerned may actively participate in the identification and assessment of caves.

The assessment team is required to use the Cave Assessment Form in assessing identified caves within their jurisdiction. For caves where the old detailed cave assessment form was used, apply the new cave assessment form.

Review, Recommendation, and Approval – After the cave assessment, the assessment team shall submit its recommendation to the CENRO whether to open or temporarily close a cave for further studies. Those recommended as open caves shall be reviewed and affirmed by the CENRO. Afterwards, the CENRO shall assign initial classification and general management prescriptions.

In case of caves within protected areas, the CENRO/PASu shall transmit recommendations to the Regional Cave Management Committee (RCMC) chaired by the Regional Technical Director (RTD) for Protected Areas, Wildlife and Coastal Zone Management Services (PAWCZMS) or the Protected Area Management Board (PAMB). The RCMC or PAMB shall conduct the final evaluation and necessary consultations with stakeholders concerned on the recommendation of the CENRO/PASu. Also, they shall endorse the recommended classification for approval to the DENR Regional Executive Director.

The Regional Office shall submit the approved classified caves to PAWB. Afterwards, PAWB shall prepare the consolidated list and the DENR Secretary shall publish an annual list of classified caves.

IV. What will happen to caves recommended for closure?

Caves recommended for temporary closure will be subjected initially to extensive cave research by the cave coordinating agencies.

The procedural flow for the entire cave classification process is presented in Figure 1.

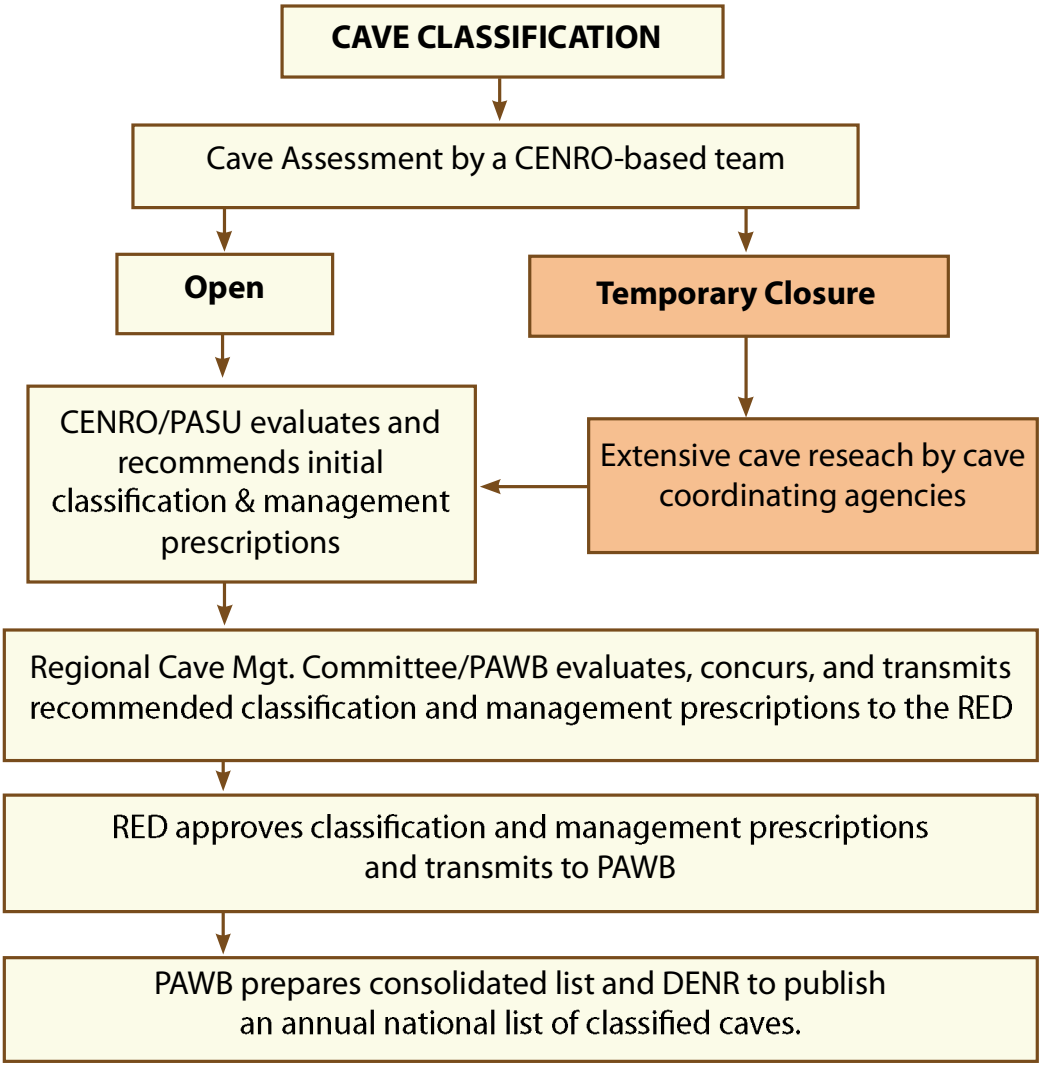


Figure 1. Cave Classification Flowchart

V. Classification of caves and factors to be considered in classification

Caves are classified based on protection of geological, biological, cultural, and paleontological features and to provide safe recreational, educational, scientific, and other resource-based utilization opportunities.

The following shall be the classes of caves.

Class I. Caves with delicate and fragile geological formations, threatened species, archaeological and paleontological values, and extremely hazardous conditions. Allowable use may include mapping, photography, educational, and scientific purposes.

Class II. Caves with areas or portions that have hazardous conditions. Allowable use may include mapping, photography, educational, and scientific purposes.

Class III. Caves generally safe to inexperienced visitors with no known threatened species, archaeological, geological, cultural, and historical values. These caves may also be utilized for economic purposes such as guano extraction and edible birds nest collection.

FACTORS TO BE CONSIDERED IN CLOSING PORTIONS OF CAVES

Portions of a cave may be closed due to the existence of any of these attributes: 1) extremely hazardous passages, 2) extremely fragile and unique geological features, 3) unique or endangered species, 4) archaeological, historic and ethnographic information, and resource values, and 5) special value.

1. Extremely Hazardous Passages

a. Bad air

Bad air refers to the condition of air in caves characterized by low levels of oxygen, high levels of carbon dioxide and other hazardous gases such as methane. Low levels of oxygen and high levels of carbon dioxide in caves or certain cave passages pose dangers to the human body. Bad air is indicated by hyperventilation, increased heart rate, dizziness, dry acidic taste in the mouth, increased pulse rate, labored breathing, and headache. Annex C provides general information on the relationship between caves and levels of CO_2 and O_2.

Indicators of low oxygen level that can be dangerous to human life may include difficulty in maintaining open flame as in candles or a flame from a carbide lamp.

Photo courtesy of Gaia Exploration Club (GEC)

b. Difficult Access

Difficult access is characterized by caves or cave passages with any of the following factors: vertical entrances and passages which require the use of rope and rigging techniques for ascending and descending, unstable substrate, squeezes, difficult rigging slope, loose rock formation, and wet/slippery conditions.

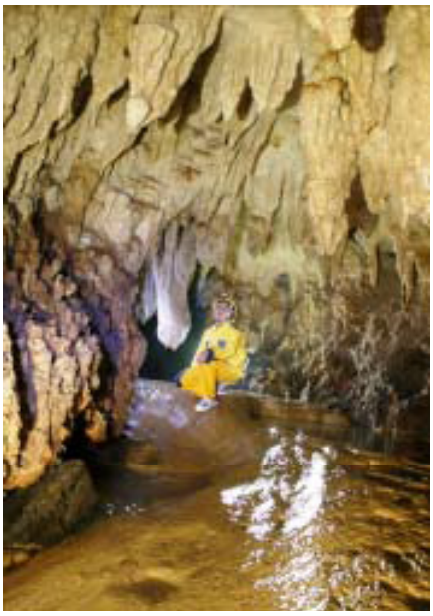
For safety purposes, these areas should be closed to the general public. However, accredited experienced cavers and collectors of birds' nest may be allowed entry to these areas.

c. Waterlogged and Flood-Prone Caves or Cave Passages

Waterlogged and flood-prone caves are characterized by flooding indications on cave walls, large volume of swiftly running water, and deep sumps and pools.

2. Decorated Caves

Caves with speleothems and speleogens (see Annex D) are prone to destruction by visitor entry, thus, must be closed to the general public until a proper management prescription is in place. Examples of such caves are Heaven Cave in Capisaan, Nueva Vizcaya and Crystal Cave in Sagada, Mt. Province.



Alena Cave
Photography by Roderick C. Parcon with the Davao Speleological & Conservation Society (DSpeCS)

Below is a list of speleothems and speleogens found in caves:

SPELEOTHEMS

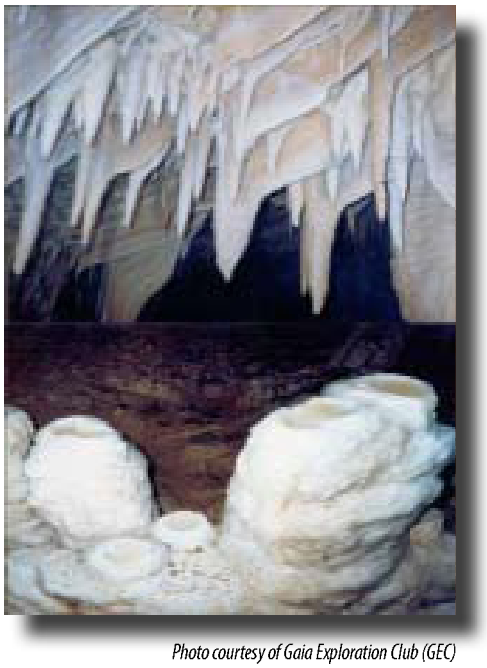


Photo courtesy of Gaia Exploration Club (GEC)

A. Dripstone and Flowstone Forms
(gravity controlled)

- Stalactites
- Stalagmites
- Draperies
- Flowstones

B. Erratic Forms
(crystal growth controlled)

- Shields
- Helictites
- Botryoidal forms (popcorns, grape, etc.)
- Anthodites
- Oulopholites (gypsum flowers)
- Moonmilk
- Sub-aqueous Forms
- Rimstone dams (gour pools)
- Concretions of Various kinds such as cave pearls
- Pool Deposits
- Crystal linings

SPELEOGENS

- Scallops
- Meander Niches
- Petromorphs
- Rock Pendants

Caves with above features being used for ecotourism purposes may continue to be used for such purposes provided that necessary protective measures and interpretation facilities are installed.

3. Rare, Endangered, and Endemic Species

Organisms found in caves have special characteristics and features to survive in such an environment. Most troglobites and troglophiles are rare while some trogloxenes are endangered (see Annex E). Any visitor entry would have irreversible effect or damage on the cave environment.

4. Paleontological, Archeological, Historical and Ethnographical Value

a. Presence of artifacts with archaeological and historical value

The presence of artifacts and ecofacts indicate the archeological value of the cave. Artifacts may be in the form of stone tools, shell tools, pottery, metal implements, tradeware ceramics, wooden coffins while ecofacts include human bones, animal bones, wood and shells. Meanwhile, artworks on walls may be in the form of charcoal drawings, hematite paintings, and engraved artwork.

All of the above provide an invaluable window to our past. Therefore, such discoveries necessitate immediate closing of the cave for further studies (see Annex F).

b. Paleontological Value

Fossils are preserved remains of prehistoric plants or animals which tell us nearly all we know about the history of life on Earth. Most fossils are formed on the seabed and are most commonly embedded in limestone caves.

c. Historical Value

Caves can be declared of historical value if they fulfill the following criteria: 1) Caves that are strongly associated with important historical events or personages and other illustrious Filipinos who have achieved an enduring contribution toward the enrichment of Filipino cultural heritage (ex., Pamitinan Cave, the scene of the "First Cry of Independence" as historian TM Kalaw proclaims); 2) those that depict local aesthetic values and those related to a significant cultural historic experience of Filipinos (ex., Ransang petroglyps); 3) those that bear strong foreign influences and those with strong evidences of an active political, social, economic, and cultural relations with neighboring countries.

d. Anthropological/Ethnographic Value

Caves with anthropological or ethnographic value include those with burial grounds, habitation sites or ancestral domain, ancestral land, and sites for traditional and religious practices and rituals.

The Cave Coordinating Agencies shall determine whether caves closed for biological, geological, archeological, paleontological, and historical research and exploration may be opened to the general public. The Tao't Bato cave in Palawan is an example of a cave that has been opened for ecotourism purposes after the archeological exploration and studies of the National Museum were completed.

5. Special Consideration

Caves may be developed and converted into show caves based on the Department of Tourism's (DOT) evaluation for ecotourism sites (see Annex G.)

Okbot Cave. *Photography by Roderick C. Parcon with the Davao Speleological & Conservation Society (DSpeCS)*

ANNEX A

British Caving Research Association (BCRA)

GRADING FOR A CAVE SURVEY CENTER LINE

Grade 1	A sketch of low accuracy where no measurements have been made
Grade 2	May be used if necessary to describe a sketch that is intermediate in accuracy between grade 1 and grade 3 (use only if necessary. See note 7)
Grade 3	A rough magnetic survey. Horizontal and vertical angles measured to +/- 2.5 degrees; Distances measured to +/- 50cm; station position error less than +/- 50cm
Grade 4	May be used if necessary to describe a sketch that fails to attain all the requirements of a grade 5 but is more accurate than a grade 3 (use only if necessary. See note 7)
Grade 5	A magnetic survey. Horizontal and vertical angles accurate to +/- 1 degree; distances accurate to +/- 10cm; station position error less than 10cm
Grade 6	A magnetic survey that is more accurate than grade 5 (see note 5)
Grade X	A survey that is based primarily on the use of theodolite instead of a compass (see notes 6 and 10 below)

CLASSIFICATION FOR CAVE SURVEY DETAIL

1	The above table is a summary and intended only as an aide memoire; the definitions of survey grades given above must be read in conjunction with the comments below.
2	In all cases it is necessary to follow the spirit of the definition and not just the letter.
3	STATION POSITION ERROR is the maximum distance between any of the points to which and from which the various measurements were made at that station.
4	ACCURACY means the nearness of a result to the true value; it must not be confused with PRECISION which is the nearness of a number of repeat results to each other, irrespective of their accuracy.
5	To attain grade 3, it is necessary to use a clinometer in passages having an appreciable slope.
6	It is essential for instruments to be properly calibrated to attain grade 5; the methods are described in "Surveying Caves" and in "An Introduction to Cave Surveying."
7	A grade 6 survey requires the compass to be used at the limit of possible accuracy, i.e. accurate to +/- 5 degrees; clinometer readings must be to the same accuracy. Distances and station position error must be accurate to at least +/- 2.5cm and will require the use of tripods or similar techniques.
8	A grade X survey must include on the drawing notes describing the instruments and techniques used, together with an estimate of the probable accuracy of the survey compared with grade 3, 5 or 6 surveys.
9	Grades 2 and 4 are for use only when, at some stage of the survey, physical conditions have prevented the surveyor from attaining all the requirements for the next higher grade and it is not practical to re-survey.
10	Caving organizations, etc. are encouraged to reproduce figures 1 and 2 in their own publications; permission is not required from the British Cave Research Association to do so. However, the tabular summary must not be re-published without these notes.

CLASSIFICATION FOR CAVE SURVEY DETAIL

CLASS A	All passage details based on memory.
CLASS B	Passage details estimated and recorded in the cave.
CLASS C	Measurements of detail made at survey stations only.
CLASS D	Measurements of detail made at survey stations and whenever necessary between stations to show significant changes in passage shape, size, direction, etc.
NOTE	The accuracy of the detail should be appropriate to the accuracy of the center line. Normally only one of the following combinations should be used: Grade 1A, Grade 3B or 3C, Grade 5C or 5D, Grade 6D, Grade XA, XB, XC, XD.

Photo courtesy of Gaia Exploration Club (GEC)

ANNEX B

CAVE ASSESSMENT FORM

Name of Cave: _____

Location: _____

Region: _____ Province:_____

Municipality: _____ Barangay:_____

Sitio: _____

Size of the Area: _____ ha (area enclosed by the proposed boundary)

Date of Assessment:_____

General Instruction: Attach site level and regional maps. Include cave maps if available.

I. General Information

1. Evolution of the Cave (include cave's origin, solution, tectonic movement, etc.)
_____

2. Geographic location and Description

Coordinates : _____ Elevation:_____

Physiography_____

3. Land Status *(please check)*

_____A & D _____Unclassified public forest
_____Timberland _____Private
_____Others (specify)_____

4. Accessibility

(State how the cave can be reached from the nearest barangay; indicate distance, means of transportation) _____

5. Climatological data *(rainfall pattern, climate type)* _____

6. Existing land-use patterns in area adjacent to the cave.

LISTING BY TYPE	AREA (ha)
Reforestation area	
Reservation	
Logging	
Grazing/Pasture	
Settlements	
Mineral Extraction	
Others	

7. **Demographic Information** (secondary data gathered from municipality, indicate)

Name of Barangay	Number of Household	Barangay Population	Means of Livelihood

8. **Current Uses / Human Activities**
Identify the current activities inside the cave

Type of Activity	Duration	Area Covered	Implementing Agencies/Orgs.	Remarks

9. **Physical Features**

a. Cave Map (Describe the size of the cave, length, height and width, its mouth, floor, and ceiling) available cave map should conform to British Cave Research Association standard of Grade 3C or higher.

b. Status of the Cave *(please check)*

b.1 ( ) Pristine Cave (virgin or newly discovered cave; immensely decorated)

b.2 ( ) Intact *(State what probable factors could have worked for their protection)*

___difficult access
___within protected area
___inside private property

b.3 ( ) Vandalized *(State extent, location of vandalism; describe vandalism)*

b.4 ( ) Exploited *(State cause and extent of exploitation)*

b.5 ( ) Claimant *(State name)*

b.6 ( ) Others *(Specify)*

Photography by Roderick C. Parcon with the Davao Speleological & Conservation Society (DSpeCS)

II. NATURAL FEATURES

1. Vegetative Cover *(Surface; inside cave; enumerate plant species)*

1.1 Flora outside the cave

Local Name	Scientific Name	Uses	Importance/ Value

1.2 Flora inside the Cave

Local Name	Scientific Name	Uses	Importance/ Value

2. Fauna

2.1 Enumerate species of fauna found inside the Cave

Instructions: Tick (x) the cell before the type of organism you observed in the cave. Estimate its number and indicate accordingly in the Number column after each organism. Whenever possible, tick the column of the corresponding cave zone where the organism was observed. Write additional observations under Remarks (For bats, note if nursing mothers or baby bats are present; for birds, note if nests, eggs or hatchlings are present). Attach additional sheets if necessary.

Organism	Local Name	Scientific Name	Common Name	Nos.	Cave Zone Twilight Dark	Threatened species	Conservation Status	Remarks

2.2 Enumerate species of fauna found outside the Cave *(Attach additional sheets if necessary)*

Local/Common Name	Scientific Name	Conservation Status	Distribution			Remarks
			Resident	Endemic	Migratory	

3. Geology

3.1 Fill details for speleothems found inside the cave.

Speleothem	Approximate No.	Zone		Remarks
		Twilight	Dark	
Dripstone and Flowstone Forms (gravity controlled)				
Stalactites				
Stalagmites				
Draperies				
Flowstone Sheets				
Columns				
Others				
Erratic Forms (crystal growth controlled)				
Shields				
Helictites				
Botryoidal Forms (popcorns, grapes, etc.)				
Anthodites				
Oulopholites (gypsum flowers)				
Moonmilk				
Others				
Sub-aqueous				
Rimstone dams (gour pools)				
Concretions of various kinds (limestone concretions e.g. cave pearls, iron, basalt)				
Pool deposits				
Crystal Linings				
Others				

Enumerate mineral deposits inside the cave

Common Minerals Found Inside the Cave
Aragonite
Calcite
Dolomite
Huntite
Hydromagnesite
Magnesite
Others

3. What are the other geological features inside the cave?

Geologic Features Inside the Cave	Location
Faults	
Joints	
Cracks	
Fossils (paleontological feature)	
Others	

4. Hydrology

4.1 What are the hydrological features inside the cave?

Feature	Perennial	Intermittent	Natural	Man-made	Size/Volume	Remarks

**For rivers, indicate direction of flow relative to the entrance. Indicate location and reference points.*

4.2 What are the hydrological features outside the cave?

Features	Number	Perennial	Intermittent	Natural	Man-made	Remarks
Pools/sumps						
Rivers						
Falls						
Others (Specify)						

5. Cave Hazards/Safety *(Please indicate if any of the following are present and their location inside the cave)*

Cave Hazards	**Location Inside Cave**	**Remarks**
bad air (from guano, poor air circulation, low supply of oxygen)		
presence of swiftly running underground river system		
deep sumps or pools		
flooding indications		
vertical pitches/entrances		
tight crawlways/squeezes		
presence of rockfall		
presence of breakdown		
deep mud		
unstable flooring		
Sharp rocks		
Extremely cold temperatures		

III. ANTHROPOLOGICAL FEATURES

Are there indigenous peoples (IP's) or settlers living within the general location? If yes, then specify the name of the IP and other information listed below.

IP	Approximate Population	Livelihood Activities	Traditional Uses/ Cultural Activities

IV. ARCHAEOLOGICAL FEATURES

1. Are there artifacts and ecofacts on the present floor area of the cave, rock shelter or overhang?
   ___Yes ___No

2. What are the artifacts present?
   ___stone tools (flaked)
   ___stone tools (polished)
   ___shell tools
   ___tradeware ceramics (porcelain)
   ___pottery (earthenware)
   ___pottery (earthenware with designs)
   ___metal implements
   ___wooden coffins

3. What are the ecofacts present?
   ___human bones
   ___animal bones
   ___wood
   ___shells (land)
   ___shells (freshwater)
   ___shells (marine)

4. Are there artworks on the wall?
   ___charcoal drawings
   ___hematite paintings
   ___engraved artwork

V. THREATS, PROBLEMS, AND POSSIBLE SOLUTIONS

Identify and describe the actual and/or potential threats, conflicts (man-made or natural) and other forms of disturbances that could affect the integrity of the cave.

Problems	Current	Potential
Deforestation		
Agriculture		
Urbanization and Industry		
Tourism and Recreation		
Chemical Waste		
Water Exploitation (dams, groundwater pumping, inundation)		
Others		

VI. POTENTIAL USES OF THE CAVE

Potential Uses of the Cave
Scientific Research
Tourism and Recreation
Exploration
Others

VII. Recommendations

Prepared by:
Concurred by:
For regional: (PAWCZMS)
For field personnel (CENRO/PENRO)
For composite team (PAWCZMS, CENRO, PENRO)

Note: *Supplemental forms may be used to gather more information about the caves.*

ANNEX C

Excerpted from

"Caves, Carbon Dioxide and You"

For detailed information on carbon dioxide concentration and reduced oxygen concentrations in caves, please refer to the complete article.

Photography by Roderick C. Parcon with the Davao Speleological & Conservation Society (DSpeCS)

Condensed from a comprehensive paper by Garry K. Smith presented at the 21st biennial Australian Speleological Federation Conference 1997 (published in the proceedings) and an article published in the 1993 Australian Caver No. 133, Pages 20- 23. For more detailed information refer to these papers. Mr. Smith is a member of the Newcastle & Hunter Valley Speleological Society-NSW Australia and the Australian Speleological Federation.

Carbon dioxide (CO_2) is the body's regulator of the breathing function. It is normally present in the air at a concentration of 0.03% by volume. Any increase above this level will cause accelerated breathing and heart rate. A concentration of 10% can cause respiratory paralysis and death within a few minutes. In industry, the maximum safe working level recommended for an eight hour working day is 0.5% .

Caves often contain elevated levels of carbon dioxide (CO_2), consequently, cavers may be putting themselves at risk without really knowing the full potential danger.

A cave atmosphere containing greater than one percent carbon dioxide (CO_2) is called Foul Air. This is the most likely hazard to be encountered in deep limestone caves with relatively still atmospheres. Having said that, one must be aware that there are many caving areas around Australia, where foul air is not a significant problem.

To the novice caver the first encounter with foul air is often a frightening experience. Typically there is no smell or visual sign associated with foul air and the first signs are increased pulse and breathing rates. Higher concentrations of CO_2 lead to clumsiness, severe headaches, dizziness, and even death. Experienced foul air cavers can notice a dry acidic taste in their mouth, however, the average caver may not notice this effect.

Because an elevated CO_2 concentration in caves corresponds to a depletion in O_2, cavers have for many years used the naked flame test to determine whether the cave atmosphere contained an elevated level of CO_2. The naked flame test involves lighting a match or cigarette lighter in the cave air, or carrying a burning candle into a suspected foul air area of the cave and the flame would extinguish when a particular concentration was reached. This test has in the past been widely accepted by the caving fraternity as a fairly accurate indication of percentage concentrations. During January 1997, I undertook extensive testing in controlled atmospheres which revealed that the Naked Flame Test is not a reliable test of CO_2 concentrations, other than to indicate that the cave atmosphere is most likely dangerous to human life.

In fact the naked flame is only measuring the O_2 concentration and the CO_2 has such a small influence over combustion that it can be ignored within the concentration range found in caves. For example a 1% increase in CO_2 concentration will raise the O_2 concentration required to support combustion of a given fuel by less than 0.05% O_2.

Without sophisticated measuring instruments, a caver cannot determine the CO_2 concentration as the flame test only measures a lack of oxygen. To make things really complicated, it is not the lack of oxygen which is the real danger in the majority of cave atmospheres but the elevated CO_2 concentration.

EFFECTS OF CO_2 ON HUMANS

As each person's body has a slightly different reaction and tolerance to stressful situations the following symptoms are general. However, nobody is immune to the dangers of CO_2.

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

ANNEX D

Generally accepted physiological effects of CO_2 at various concentrations by volume.

Concentration	Comments
0.03%	Nothing happens as this is the normal carbon dioxide concentration in air.
0.5%	Lung ventilation increases by five percent. This is the maximum safe working level recommended for an eight hour working day in industry (Australian Standard).
1.0%	Symptoms may begin to occur, such as feeling hot and clammy, lack of attention to details, fatigue, anxiety, clumsiness and loss of energy, which is commonly first noticed as a weakness in the knees (jelly legs).
2.0%	Lung ventilation increases by 50 percent, headache after several hours exposure. Accumulation of carbon dioxide in the body after prolonged breathing of air containing around two percent or greater will disturb body function by causing the tissue fluids to become too acidic. This will result in loss of energy and feeling run-down even after leaving the cave. It may take the person up to several days in a good environment for the body metabolism to return to normal.
3.0%	Lung ventilation increases by 100 percent, panting after exertion. Symptoms may include: headaches, dizziness, and possible vision disturbance such as speckled stars.
5 - 10%	Violent panting and fatigue to the point of exhaustion merely from respiration & severe headache. Prolonged exposure at 5% could result in irreversible effects to health. Prolonged exposure at > 6% could result in unconsciousness and death.
10 - 15%	Intolerable panting, severe headaches and rapid exhaustion. Exposure for a few minutes will result in unconsciousness and suffocation without warning.
25% to 30%	Extremely high concentrations will cause coma and convulsions within one minute of exposure. Certain death.

Effects of O_2 deficiency on Humans

If we consider an atmosphere consisting of just N_2 and O_2, where the O_2 is at a lower concentration than the normal atmosphere, the human body would be affected in the following manner:

Generally accepted physiological effects of reduced O_2 concentrations

O_2% by volume.	Symptoms
reduced from 21 to 14%	First perceptible signs with increased rate and volume of breathing, accelerated pulse rate and diminished ability to maintain attention.
between 14 to 10%	Consciousness continues but judgment becomes faulty. Rapid fatigue following exertion. Emotions effected, in particularly ill temper is easily aroused.
10 to 6%	Can cause nausea and vomiting. Loss of ability to perform any vigorous movement or even move at all. Often, the victim may not be aware that anything is wrong until s/he collapses and is unable to walk or crawl. Even if resuscitation is possible, there may be a permanent brain damage.
below 6%	Gasping breath. Convulsive movements may occur. Breathing stops but heart may continue beating for a few minutes--ultimately, death.

ANNEX E

WHAT TO DO WHEN ENCOUNTERING CO_2

A test should be made as soon as foul air is suspected. If a naked flame test fails, then all members of the party should immediately exit the cave in an orderly manner without panicking. Inexperienced cavers in the group should be especially watched and guided to the entrance.

When undertaking vertical pitches in caves suspected of foul air the first person down should make thorough checks for CO_2. Beside carrying ascenders, a safety belay is a wise option in the event that the first person down may be overcome when suddenly descending into an area of high concentration.

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

A safety belay should be mandatory with all pitches where a ladder is more than just a handhold.

Cavers should only enter areas of foul air during special circumstances, such as search and rescue operations, exploration and scientific work. Under these circumstances, special precautions should be taken to ensure the safety of the group. For more information regarding safety precautions refer to Australian Speleological Federation (ASF) Cave Guidelines.

CONCLUSION

1. If sophisticated measuring equipment is not available, the best advice is to carry out a "Naked Flame Test" when you or a member of your group experiences the first signs of labored breathing, headaches, clumsiness, loss of energy or any of the other signs associated with elevated concentrations of CO_2. Ideally, cavers should use a cigarette lighter flame to reduce the amount of unpleasant fumes emitted from matches burnt by people experimenting in the confines of a cave. The best advice is, "If in doubt, get out" in an orderly manner.

2. Laboratory tests have proven that combustion of a match, candle or butane cigarette lighter will cease at about 14.5% to 15% concentration of oxygen. Twenty one percent (21%) being the oxygen concentration in normal atmosphere. Bearing in mind that humans on average breathe out air containing 15% oxygen and this is enough to revive a person using mouth-to-mouth resuscitation. In fact, humans can survive in an atmosphere containing 10% oxygen, so when the flame test just fails, it is still measuring an atmosphere containing enough oxygen to survive.

3. The real danger is the carbon dioxide concentration which is the main trigger for the human body to increase the breathing rate. Prolonged exposure to a concentration of just five or six percent may be enough to cause suffocation. In the majority of cases, if a person has any of the symptoms of elevated carbon dioxide levels, a simple naked flame test will fail to ignite. This is a sure sign of foul air and it is time to get out.

ANNEX F

GENERAL DESCRIPTION OF SPELEOTHEM AND SPELEOGENS

(field identification guide for DENR field personnel and other cave users**)**

Dave Burnell

CAVE CORALS/CORALLOIDS

Small clusters of individual knobs formed by slowly seeping water

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

STALACTITES

Icicle-shaped precipitates of $CaCO_3$ hanging from the ceiling

Dave Burnell

POOL SPAR

Well-defined crystals which grow underwater in cave pools

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

HELICTITES

Twisted or spiraling cylinders or needles apparently developed when water seeps through the ceiling slowly that slight chemical or physical changes can cause reorientation of the crystal structure of calcite or gypsum

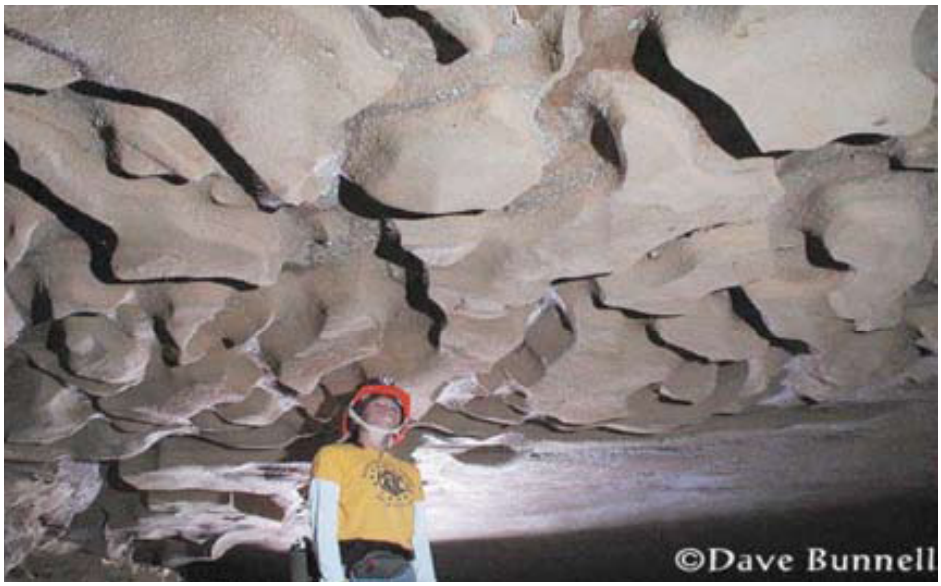
STALAGMITES

Precipitates of $CaCO_3$ that grow upward from the floor as a result of water dripping from overhanging stalactites

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

COLUMNS

Stalactites and stalagmites that have eventually met and joined together



SPELEOGENS

These are not mineral or crystal deposits; rather, they are part of the bedrock the cave is formed in that has been sculpted by erosion or dissolved into distinct interesting forms.

SHIELDS

These form as calcite-rich seep water under hydrostatic pressure is forced from tiny cracks in a cave wall, ceiling, or floor; as this seep water loses CO_2 to the cave air, calcite is deposited as parallel extensions of the cracks in the walls

Dave Burnett

RIMSTONE DAMS

These are raised fence-like deposits of calcite on the cave floor that form around pools of water

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

ANNEX G

GENERAL DESCRIPTION OF CAVE FLORA AND FAUNA

Cave organisms are classified into the following:

a. Troglobites - True cave dwellers. They are obliged to live in the deep zone and show significant eye and pigment reduction. These creatures are relatively rare and are unable to survive outside the cave environment. The often bizarre cave beetles with absent or residual non-functional eyes and long antennae provide one example of true cave dwellers. Troglobites are mostly endemic species thus require special care and be left undisturbed.

b. Troglophiles - Species that use the deep cave environment but show little eye and pigment reduction are facultative cave dwellers. They live and breed inside the cave, but on the basis of their morphology it is assumed that they can live on the surface as well, usually in similar dark, humid microhabitats such as the undersides of fallen logs. Many cave crickets, spiders, and millipedes fall into this group. Some of these species have not been identified thus are considered unique.

c. Trogloxenes - Species often found in caves for refuge that leave to feed. Some other species wander into caves accidentally but cannot survive there. Bats and swiftlets are good examples of this group. There are bat species that are endangered while others are in maternity roost thus should not be disturbed.

For aquatic organisms there is a parallel classification:

a. Stygobites – Those highly specialized animals living entirely in the groundwater environment, and absent in surface waters

b.Stygophiles -Found in both surface and underground waters without adaptation to subterranean life

c. Stygoxenes -Organisms that appear rarely, and almost randomly, in under ground waters but are essentially surface dwellers

ANNEX H

Archaeological Use of Caves

"Cave sites have been one of the major geologic features which contain in-site archaeological as well as paleontological materials. The semi-close structures of caves make the deposition or burial of archaeological materials pristine. Some of the oldest homonid fossils were found in caves or even in sinkholes. In Sterkfontein cave system in Africa, the fossil remains of *A. africanus* was found dating to 4.4 mya. Another famous cave in Africa is the Klassies River mouth cave system where the oldest fossil of an archaic *Homo sapiens* dating 120,000 years ago was found.

"In Europe, cave sites depicting Mousterian to solutrean stone technology were found. Caves were also used by early humans not only for habitation but also in ritualistic activities as represented by cave art such as those in Altamira, Spain. In the Philippines, caves were used by early humans as early as 50,000 years ago as the new dating for Tabon Caves (Palawan) would signify. In the Callao limestone formation (Cagayan), transition from a hunting-gathering subsistence strategy to horticulture can be studied through the cave depositions.

Clearly, our past was recorded in the buried deposits in caves. In order to understand our past, preservation of cave sites is important. To preserve these rich archaeological resources, excavation should not be conducted without the supervision or direction of an archaeologist .

"Clearly, our past was recorded in the buried deposits in caves. In order to understand our past, preservation of cave sites is important. To preserve these rich archaeological resources, excavation should not be conducted without the supervision or direction of an archaeologist. All caves, both wet and dry, have potential as archaeological deposits. Some caves could have them on the surface, while some are buried and would require test excavation for verification.

"The public as well as people who use caves for recreation could help in the identification of archaeological use of caves. Surface finds in cave sites can easily be identified. Some of the common surface finds are stone tools such as flakes and core tools, earthenware sherds, human skeletal remains, and animal bones. Flake stones are intentionally detached piece from a core through percussion, and can be utilized for cutting and scraping. Core tools on the other hand are pebble-size stones where at least three flakes were detached on one edge-face to produce a sharp edge.

"This can be used for chopping purposes. Earthenware is made from clay and fired to produce a container. They can be used for utilitarian purposes such as serving or cooking pots, as burial jars, and in ritual activities. When they break into pieces, they are called sherds. The public can then be informed regarding their identification and reporting to the National Museum by disseminating brochures on archaeological use of caves. Recreational cavers as well as government officials involved in cave protection could undergo seminars on surface identification of archaeological materials and use the brochure as a field guide."

-"Archaeological Use of Caves" by Armand Salvador B. Mijares - Head, Terrestrial Archaeology Section, National Museum, 2002.

Photography by Ralph Rios of the Gaia Exploration Club (GEC)

ANNEX I

ECOTOURISM SITE SELECTION FORM

Evaluation Form for the Selection of Key Ecotourism Sites

Instruction: Assess the site by marking or encircling the number that corresponds to the following criteria (1-low, 2-below moderate, 3-above moderate, 4-high)

Score	1	2	3	4
I. Accessibility (12%)				
a. Proximity to a major gateway/hubs				
b. Proximity to tourist service centers/spokes				
c. Transportation connectivity				
(min score of 1 and max score of 4 for each criterion; sum=12%)				
II. Accessibility Natural and Cultural Features (20%)				
a. Uniqueness of features/diversity of product				
b. Presence of biodiversity/significance of richness				
c. Current physical condition				
d. Appeal to international markets				
e. Appeal to national/domestic markets				
III. Market Demand (12%)				
a. Presence of international markets				
b. Presence of local visitors from outside the region				
c. Presence of local visitors from within the region				
IV. Availability of Ecotourism products in the market (4%)				
(Potential - 2, Emerging - 3, Existing - 4)				
Enumerate the product/s available_____				
V. Visitor services (12%)				
a. Availability & quality of accommodation & other facilities				
b. Availability & quality of support services and amenities				
c. Availability & quality of support infrastructure				
VI. Social/Political Support (24%)				
a. Community involvement/participation				
b. Government support/cooperation				
c. Private sector support/partnership				
d. Non-governmental organizations support				
e. Established linkages among sectors				
f. Benefits to the local communities				
VII. Tolerance to Impacts (12%)				
a. Social				
b. Cultural				
c. Natural Environment				
VIII. Security - safety/peace & order (4%)				

Total Point Score……..

Remarks:_____

Evaluated by: _____ Date: _____

Minimum Impact Caving Code

This code of ethics encourages practices that minimize negative impacts to caves. As we learn more about cave environments, we evaluate and redefine caver ethics. This code describes low-impact caving techniques that come from the experiences and contributions of many cavers. Think safety, take care of yourself and your team. Move with stewardship. Avoid damaging aesthetic, cultural, paleontological, geological, hydrological, biological, as well as microbial resources. Cave softly … and leave no trace.

1. Remember that every caving trip has an impact.
2. Where possible, the leader should be familiar with the cave.
3. Ensure that the party caves at the pace of the slowest caver.
4. Keep your party size small.
5. Constantly watch your head placement and of your party members.
6. Keep caving packs as small as possible.
7. Ensure that party members do not wander about the cave unnecessarily.
8. Stay on all marked or obvious paths.
9. If necessary to walk on flowstones, remove any muddy boots and clothing.
10. Recognize cave deposits that may be damaged by walking or crawling over them.
11. Take care in the placements of hands and feet throughout the cave.
12. Wash caving boots and coveralls regularly.
13. Cave must not be disfigured by unnecessary markings.
14. Treat the cave biota with respect.
15. Ensure that all foreign matter is removed and disposed of properly from the cave.
16. No smoking.
17. No camping.
18. CAVE SOFTLY.

G L O S S A R Y

ANTHRODITE radiating clumps of crystalline aragonite. Tufts of crystals radiate from a common center resulting in a spiky appearance.

ARAGONITE a less common crystalline form of calcium carbonate than calcite, denser and orthorhombic.

ARTHROPOD the most common group of animals inhabiting caves, including insects, crustaceans, spiders, millipedes, etc. They have jointed limbs and external skeletons.

ARCHAEOLOGY refers to the scientific study of material remains (such as fossils, relics, artifacts, ecofacts, features and monuments of post-human life and activities; remains of the culture of a people.

BAD AIR (see Foul Air) A cave atmosphere containing greater than 1% carbon dioxide (CO_2); often characterized by increased pulse and breathing rates; leads to higher concentrations of CO_2 lead to clumsiness, severe headaches, dizziness and even death.

BIOSPELEOLOGY the scientific study of organisms living in caves.

BOTRYOID small bead or knob-like projections from cave walls. They are usually of calcite.

BREAKDOWN fall of rock from the roof or wall of a cave.

CALCITE the chief mineral in limestone, which is composed of the chemical called calcium carbonate.

CAVE any naturally occurring void, cavity, recess or system of interconnected passages beneath the surface of the earth or within a cliff or ledge and which is large enough to permit an individual to enter, whether or not the entrance, located either in private or public land, is naturally formed or man-made. It shall include any natural pit, sinkhole or other feature, which is an extension of the entrance.

CAVE PEARLS a small round calcite concretion that has formed in a shallow cave pool or floor depression.

CAVE RESOURCES includes any material or substance occurring naturally in caves, such as animal life, plant life, including paleontological and archaeological deposits, cultural artifacts or products of human activities, sediments, minerals, and speleothems.

CAVERN a very large chamber within a cave.

CAVE SYSTEM	a collection of caves interconnected by enterable passages or linked hydrologically or a cave with an extensive complex of chambers and passages.
CULTURAL RESOURCES	refer to prehistoric and historic sites, any material recovered from these sites, or places or areas of historic or religious significance. These include archaeological and ethnographic materials, such as artifacts, ecofacts, hidden deposits, features, monuments, and human fossil remains.
COLUMN	a speleothem from floor to ceiling, formed by the growth and joining of a stalactite and a stalagmite, or the growth of either to meet bedrock.
DEAD CAVE	a cave without streams or drips of water.
DARK ZONE	the part of the cave which daylight never reaches.
ETHNOGRAPHY	study of a race, people, or cultural group.
EXPLORATION	the discovery and examination of caves, often entailing digging, climbing, and diving.
FAUNA	the animals found in or peculiar to a certain region
FLORA	the whole vegetation of a country or geological period.
FLOWSTONE	a deposit formed from thin films or trickles of water over floors or walls, usually of calcite.
FOUL AIR	a cave atmosphere containing greater than 1% carbon dioxide (CO_2)
GEOLOGY	the science that deals with the composition and structures of the earth and changes, which it has undergone or is undergoing including the study of the evolution of life and the environment that has existed as recorded in the different rock sequences.
GUANO	large accumulations of bat and bird dung, often partly mineralized, including rock fragments, animal skeletal material and products of reactions between excretions and rock.
GYPSUM FLOWER	an elongated and curving deposit of gypsum on a cave surface.
HELICTITE	a smooth-surface stalactitic form that grows in curved paths instead of hanging vertically.
HYDROLOGY	the scientific study of the nature, distribution, and behavior of water.
KARST	an irregular limestone region with sinks, underground streams, and caverns.
MARBLE	limestone re-crystallized and hardened by pressure and heat.
MINERALS	naturally occurring chemical composition and crystal structure.

MOONMILK	a soft, white plastic speleothem consisting of calcite, hydro calcite, hydromagnesite or huntite.
PALEONTOLOGY	the science dealing with the life of post-geological periods as known from fossil remains.
PASSAGE	a cavity that is much longer than it is wide or high and may join larger cavities.
RIMSTONE	deposit formed by precipitation from water flowing over the rim of a pool.
SEDIMENT	material recently deposited by water, ice or wind, or precipitated from water.
SHIELDS	a massive plate or slab of travertine that juts out from the cave wall at an angle apparently determined by the arrangement of joints.
SHOW CAVE	a cave open to the general public on commercial basis.
SPELEOLOGY	scientific study or exploration of caves.
SPELEOGEN	a cave feature produced by the removal of bedrock such as ceiling pockets or scallops.
SPELEOTHEM	any natural mineral formation or deposit occurring in a cave or lava tube, including but not limited to any stalactite, stalagmite, helictite, cave flower, concretion, drapery, rimstone or formation of clay or mud. Synonym, cave formation.
SQUEEZE	an opening in a cave passable only with effort because of its small dimensions.
STALACTITE	a speleothem hanging downwards from a roof or wall.
STALAGMITE	a speleothem projecting upward from the floor that is formed by precipitation from drips.
SUMP	a point in a cave passage when the water meets the roof.
TROGLOBITE	a cave organism that is unable to live outside the cave environment.
TROGLOPHILE	a cave organism that frequently spends most of its life inside a cave but is not confined to the cave environment.
TROGLOXENE	a cave organism that spends only part of its life cycle inside the cave but frequents the surface for food.
TWILIGHT ZONE	the part of a cave which daylight penetrates.

LIST OF REFERENCES

Australian Speleological Federation Inc. Minimal Impact Caving Code 1995.

Australian Speleological Federation Inc. Code of Ethics, 1995.

Davis, Donald G. " The Carbide Lamp." Caving Basics: A Comprehensive Guide for Beginners. Rea, Thomas G.,ed. Alabama: National Speleological Society, 992. pp. 10-11

Ellis, Bryan, "An Introduction to Cave Surveying." Cave Studies Series No.2. British Cave Research Assocation, 1988.

Gillieson, David. Caves: Processes, Management and Development. Oxford: Blackwell Publishers Ltd., 1996.

Heaney, L. R., D. S. Balete, M. L. Dolar, A. C. Alcala, A. T. L. Dans, J. C. Gonzales, N. R. Ingle, M. V. Lepiten, W. L. R. Oliver, P. S. Ong, E. A. Rickart, B. R. Tabaranza, Jr., and R. C. B. Utzurrum. 1998. A synopsis of the mammalian fauna of the Philippine Islands. Fieldiana Zoology new series, 88:1-61

Jackson, Donald Dale. Underground Worlds. Time-Life Books Inc. 1982.

Judson, David.,ed. Caving Practice and Equipment, UK: British Cave Research Association and Cordee, 1991.

Lowe D. and Waltham T., A Dictionary of Karst & Caves. Bridgewater, UK: British Cave Research Association, 1995. p.35

Mijares, Armand Salvador B. "Archaeological Use of Caves", Terrestrial Archaeology Section National Museum, Manila, November 2002.

Proclamation No. 996. Declaring the Tabon Cave Complex and all of Lipunan Point in Quezon, Palawan as a Site Museum Reservation, April 11, 1972.

PD 1492. Amending PD 260 To Include the Petroglyps in the Cave at the Tau't-Batu Area in Barangay Ransang, Quezon, Palawan, June 11,1978.

Watson, John et.al., ed. Guidelines for Cave and Karst Protection, IUCN, Gland, Switzerland and Cambridge, UK. 1997.

http://www.goodearthgraphics.com/virtcave/virtcave.html

LIST OF ACRONYMS

ASF	Australian Speleological Federation
BCRA	British Caving Research Association
CENRO	Community Environment and Natural Resources Office/r
CMPCP	Cave Management Protection and Conservation Program
DENR	Department of Environment and Natural Resources
DOT	Department of Tourism
GEC	Gaia Exploration Club
LGU	Local Government Unit
NHI	National Historical Institute
NM	National Museum
PAMB	Protected Area Management Board
PASu	Protected Area Superintendent
PAWB	Protected Areas and Wildlife Bureau
PAWCZMS	Protected Areas, Wildlife and Coastal Zone Management Services
RCMC	Regional Cave Management Committee
RED	Regional Executive Director
RTD	Regional Technical Director

NOTES

NOTES

NOTES

NOTES

NOTES

Photography by Roderick C. Parcon with the Davao Speleological & Conservation Society (DSpeCS)

Writers

Armida Andres
Nelson Castillo
Marlynn Mendoza
Ofelia Espayos
Adreana Santos

Contributors

Dir. Theresa Mundita Lim

Asst. Dir. Antonio Manila

Gaia Exploration Club

Davao Speleological and Conservation Society

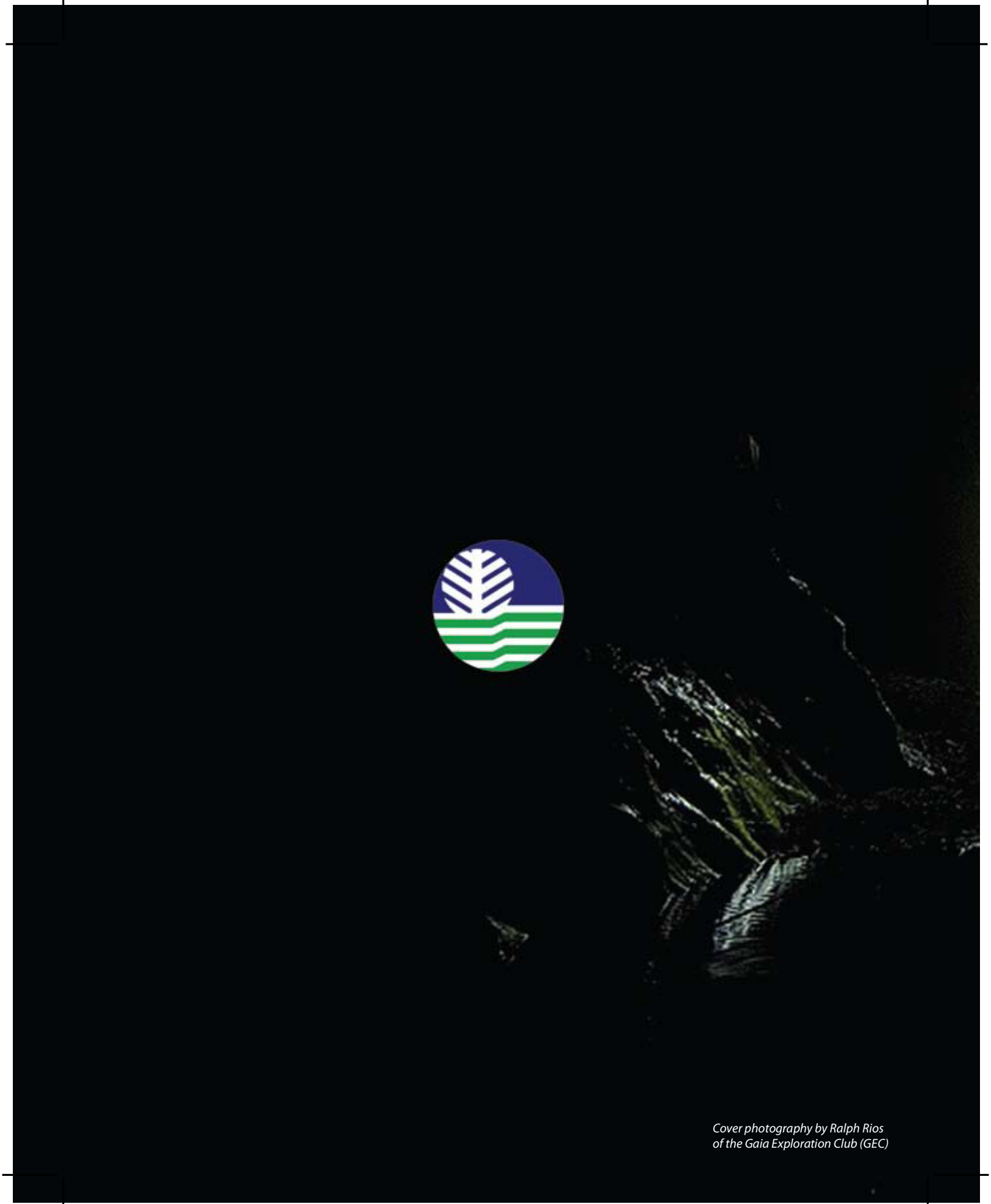
PAWB Senior Staff

Editor

Mariano Kilates

Design/Layout

Angel Gallardo, Jr.



Cover photography by Ralph Rios
of the Gaia Exploration Club (GEC)