

## **BIBLIOGRAPHY**

BAYENG, JUNALYN M., CADINGAN, RACQUEL L., CUADLA, NARHY L., LUCIO, LORIESOL W., and TONGED, DINA M. APRIL 2009. The Bio-Physico-Chemical Characteristics and Management of Bengao-ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City. Benguet State University, La Trinidad, Benguet.

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## **ABSTRACT**

The study was conducted to determine the bio-physico-chemical characteristics and management of Bengao-ngao Cave in Ambongdolan, Tublay, Benguet and Crystal Cave 1 in Bakakeng Central, Baguio City from December to January 2009.

The physico-chemical parameters measured were total suspended solids (TSS), percent relative humidity (%RH), temperature, substratum; dissolved oxygen (DO), hardness and pH. The macroscopic flora and fauna found in the cave were also identified. The study also documented the cave management practices of the two barangays using a semi-structured questionnaire and photo documentation.

There were 15 respondents that were purposively selected in each of the barangay with 10 years residential period. Five of the respondents came from the elders, another five from the tour guides or residents and five from the barangay officials.

The results of the study revealed that Bengao-ngao Cave is relatively clean as reflected by its bio-physico-chemical characteristics. Its TSS was 50mg/L, an air

temperature which ranges from 17°C – 24°C and surface and underwater temperature of 15°C – 23°C and 23°C – 23.5°C, respectively. It has also a rocky and sandy substratum. The mean DO, hardness and pH of the water were 5.25 mg/L, 154 mg/L and 7.99, respectively. The Crystal Cave 1, on the other hand, has a mean relative humidity of 84.33%, an air temperature which ranges from 15°C - 17°C and with a rocky and muddy substratum. For the biological components of the two caves, Bengao-ngao Cave is more diverse in terms of flora and faunal species than that of Crystal Cave 1. Bengao-ngao Cave harbors 7 floral species, 4 faunal species and 5 aerial and highly mobile faunal species while Crystal Cave 1 only harbors 2 floral species and 3 aerial and highly mobile faunal species.

Moreover, the results of the study revealed that Bengao-ngao Cave is well managed. There is a cooperative conservation movement among the people in the community spearheaded by the barangay officials. It was also found out that there are still indigenous practices and beliefs left in the community, which is a great help towards the cave preservation and protection though it is of minor importance. On the other hand, Crystal Cave 1 is not properly managed despite the fact that there is a private association responsible for its management as evidenced by its degraded natural/physical features.

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## INTRODUCTION

### Background of the Study

A cave is a natural opening in the ground extending beyond the zone of light and large enough to permit the entry of man (Davis and Morgan, 2000). It also refers to a naturally occurring void, cavity, recess or system of interconnected passages beneath the surface of the earth whether or not entrance is naturally open or man-made as defined in House Bill No. 1123 (Nibaten, 1996 as cited by Bahod et al., 2002). A cave is also commonly produced in the solution activity of limestone. Caves are made of different shapes of passages either a series of simple sinuous or sub angular passages; or a complex maze of interlacing, relatively straight passages. The passages may also have small openings that require crawling to pass through up to giant galleries. Furthermore, the passages are adorned with beautiful formations of stalactites, stalagmites and flowstones, which are the principal tourist attractions. Stalactites are the icicle-like hanging in the ceilings; stalagmites are the round shaped dripstone deposits under the stalactites; and the flowstone are deposits on the sheets or layers on the wall and floor (Encyclopedia Americana, 1989).

Caves provide habitats for many specialized life forms such as bats, birds, crickets, beetles, millipedes etc. which are important in the sustenance of biological processes outside the cave (National Caving Association, 1997). They have also provided shelter to prehistoric, ancient, and primitive contemporary people. Human remains, artifacts, sculptures and drawings found in caves have aided archaeologists to learn about early humans. Many religious traditions have regarded caves as sacred and have used



them to perform rituals, ceremonies, and sacrifices (Science Encyclopedia, 2008). Aldrich et al. (1970) as cited by Bahod et al. (2002) added that caves are ideal natural laboratories for study. Not only do they offer an environment where temperature, humidity and light remain fixed throughout the year, but also other unique conditions present in caves offer a surprising number of habitats for both plant and animal population.

In the Philippines, there are about 2,500 identified caves and the number may even go up to 5,000 when new caves will be discovered (DENR, 1993 as cited by Bagta et al., 2002). All these caves whether in public or private land are under the supervision of the Department of Environment and Natural Resources (DENR) and must be protected and conserved as mandated by the Republic Act 9072 known as the National Caves and Cave Resources Management and Protection Act.

Benguet, specifically in Ambongdolan, Tublay is noted of its beautiful natural caves which have attracted a lot of tourists. Among them is the Bengao-ngao cave, the largest of all the caves which lies along Payay River (The Official Site of the Provincial Capitol of Benguet, 2005). It was named after the noisy bird that thrives inside. It also serves as sanctuary for bats. The cave's stalagmites and stalactites that were formed over the years are beautiful. Some are hanging freely like silk clothes while others are like tables, plates with glitters. Furthermore, there were beliefs that it once served as hiding place of Filipino guerillas or Japanese soldiers during World War II (Shane, 2007).

Crystal Cave, on the other hand, is found in Purok Crystal Cave, Bakakeng Central, Baguio City. Crystal Cave is composed of three caves namely Cave 1, 2 and 3. Among these three, Cave 1 is frequently visited. Consequently, it is considered to have





established the popularity of the Crystal Cave as one of the tourist destinations of Baguio City. This Northeast-Southwest trending 96 meter long cave is a naturally occurring underground cave which serves as the lower drainage channel of the intermittent crystal cave creek during heavy rainfall (MGDS-DENR, 1997). At present, however, the ceilings and the walls of the cave is covered with residues of carbon soot from the smoke of torch lightings obliterating the cave's crystalline and inserted cellophanes and papers which were carried by water during rainy seasons. There are also graffiti's on the cave's wall and evidence of clipped-off rock formations. For these reasons, the cave is subjected to the scope of DAO No. 04 series of 1994 known as Cave Management and Conservation Program. Despite some evident destruction, the cave still lures visitors who are usually accompanied by local guides (FMS-DENR, 1999).

### **Objectives of the Study**

The general objective of the study was to investigate and to compare the conditions of the Bengao-ngao Cave in Ambongdolan, Tublay and the Crystal Cave 1 in Purok Crystal Cave, Bakakeng Central, Baguio City. Specifically, it aimed to:

1. Determine and compare the two caves based on their:
  - a. Physical parameters
    - 1) Total Suspended Solids (TSS)
    - 2) Percent Relative Humidity
    - 3) Temperature
    - 4) Substratum



b. Chemical parameters

- 1) Dissolved Oxygen (DO)
- 2) Hardness
- 3) pH

c. Biological parameters

- 1) Macroscopic flora
- 2) Macroscopic fauna.

2. Document and compare the management practices employed by the surrounding communities on the two caves.

### **Importance of the Study**

The study on Bengao-ngao and Crystal caves is an addition to the growing literature on the Cordilleran way of living. This can serve as baseline information for policy makers and planners in formulating developmental and conservation programs relevant for caves and their natural resources.

For the community, the study can also serve as an eye opener. There is a need to continue protecting and conserving their natural treasures such as the caves as well as their indigenous knowledge and practices instilling pride and natural beauty and resources of the Cordillerans. Furthermore, this may help them improve the technical know-how in enhancing and managing caves.

For the researchers, the conduct of the study served as a training ground. They were able to apply some of the knowledge learned and it enhanced their skills in



conducting research. The results of the study also inspired them to help further in protecting and managing the environment.

### **Scope and Delimitation of the Study**

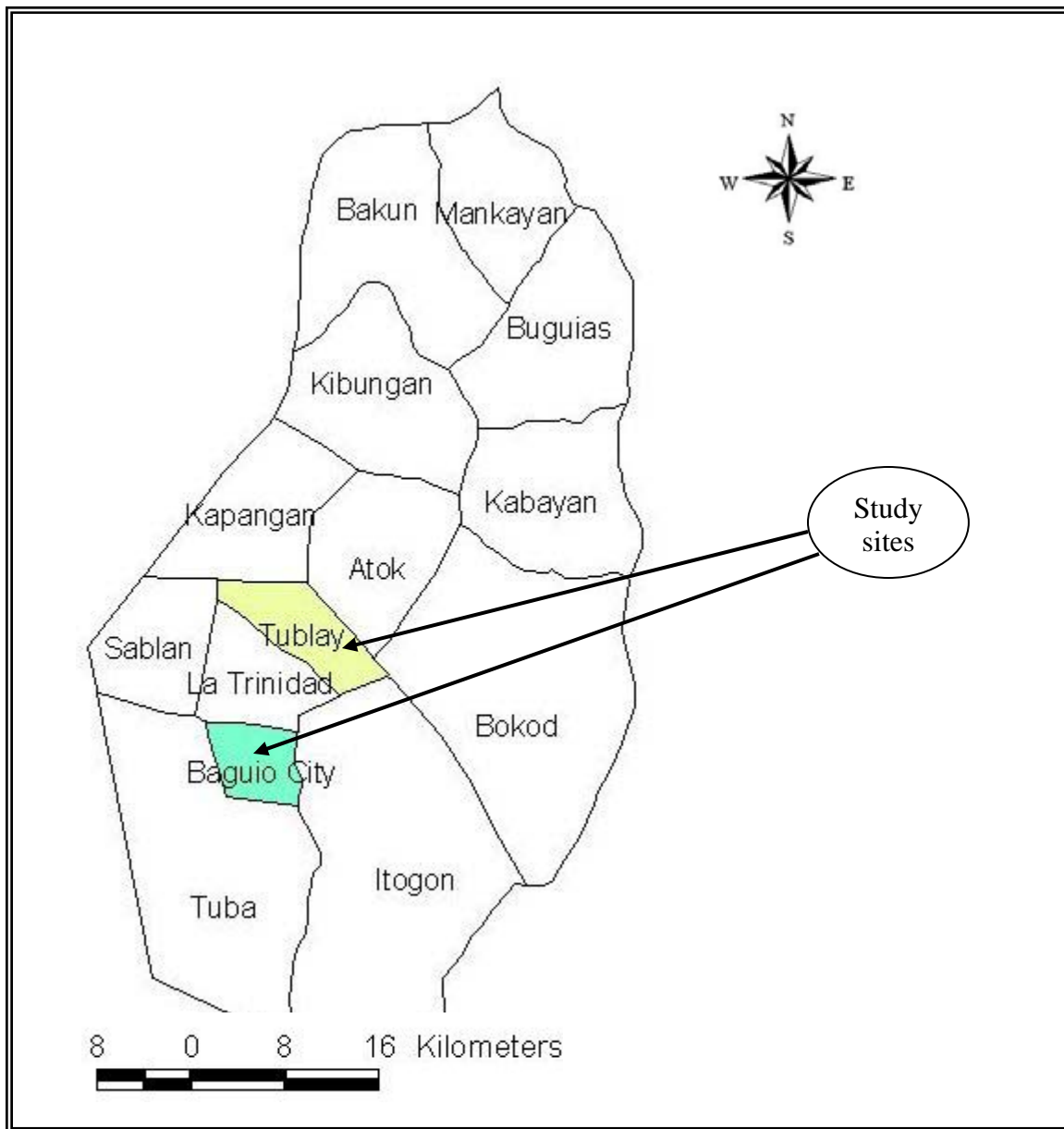
The study focused on the physical, chemical and biological characteristics of Bengao-ngao Cave and Crystal Cave 1. Three sampling stations/zones were established in each study site. These were located near the entrance zone, on the twilight zone and on the total darkness zone. Delineation of these three zones was determined based on estimated level of darkness. Under each station, TSS, percent relative humidity, temperature and substratum were measured for physical parameters; DO, hardness and pH for chemical; and macroscopic flora and fauna for the biological components of the cave. Only those species found in the plots established were identified and counted. Aerial and highly mobile animal species that were encountered or seen were also listed.

The study also determined and documented the management practices employed by the residents of Barangay Crystal Cave towards Crystal Cave 1 and the residents of Barangay Ambongdolan towards Bengao-ngao Cave using a semi-structured questionnaire. Fifteen were purposely chosen (at least ten years residential period) and interviewed in each study site.

### **Locale and Time of the Study**

The study was conducted from December 2008 to January 2009 in Ambongdolan, Tublay, Benguet where the Bengao-ngao Cave is located and in Purok Crystal Cave, Bakakeng Central, Baguio City where Crystal Cave 1 is located (Figure 1).





Source: BSU-GIS laboratory, 2008.

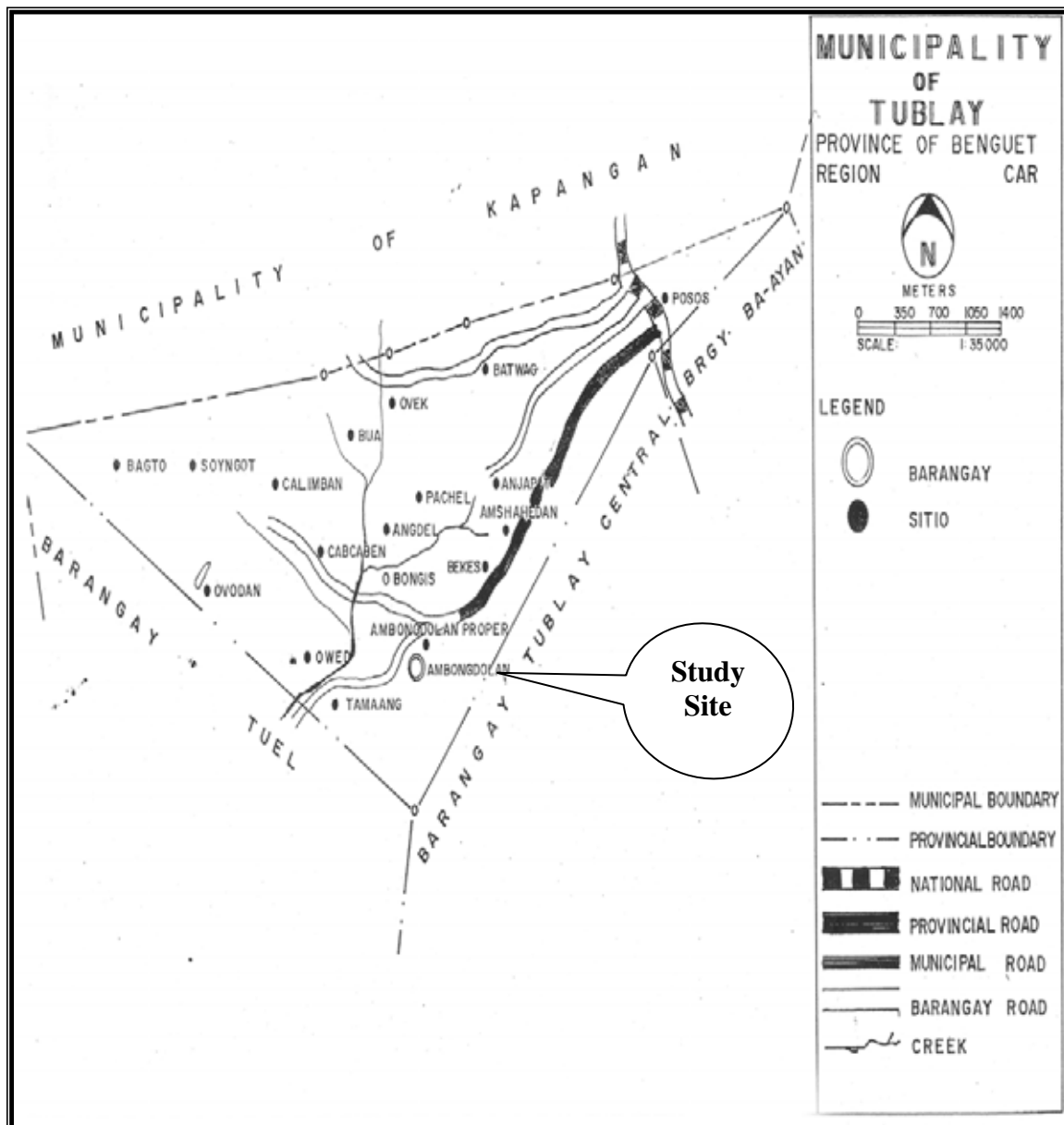
Figure 1. Map of Benguet showing the Municipality of Tublay and the City of Baguio.



Barangay Ambongdolan lies on the northern part of the Municipality of Tublay bounded on the north by the Municipality of Kapangan, on the west by Barangay Tublay Central, and on the east by Barangay Ba-ayan (Figure 2). It is approximately 42 kilometers away from the city of Baguio and 30 kilometers away from the Municipal Hall of Tublay. The barangay can be traversed through the national road, Acop-Kapangan and Alno road as shown in Figure 3 (Provincial Tourism Office of Benguet, no date).

Purok Crystal Cave, on the other hand, is about 2.5 km southwest of Baguio City Hall (MGDS-DENR, 1997). It is approximately 100 meters walking distance from the turning point of PUJ's of the said purok (FMS- DENR, 1999). The study area can be traversed through Marcos Highway turning west at the Marcos Highway-Crystal Cave Road junction (Figure 4). The barangay is consist of three caves namely, Crystal Cave 1, 2, and 3. Among these three caves, Crystal Cave 1 was the only accessible and open for tourism. Consequently, it is considered to have established the popularity of the barangay.

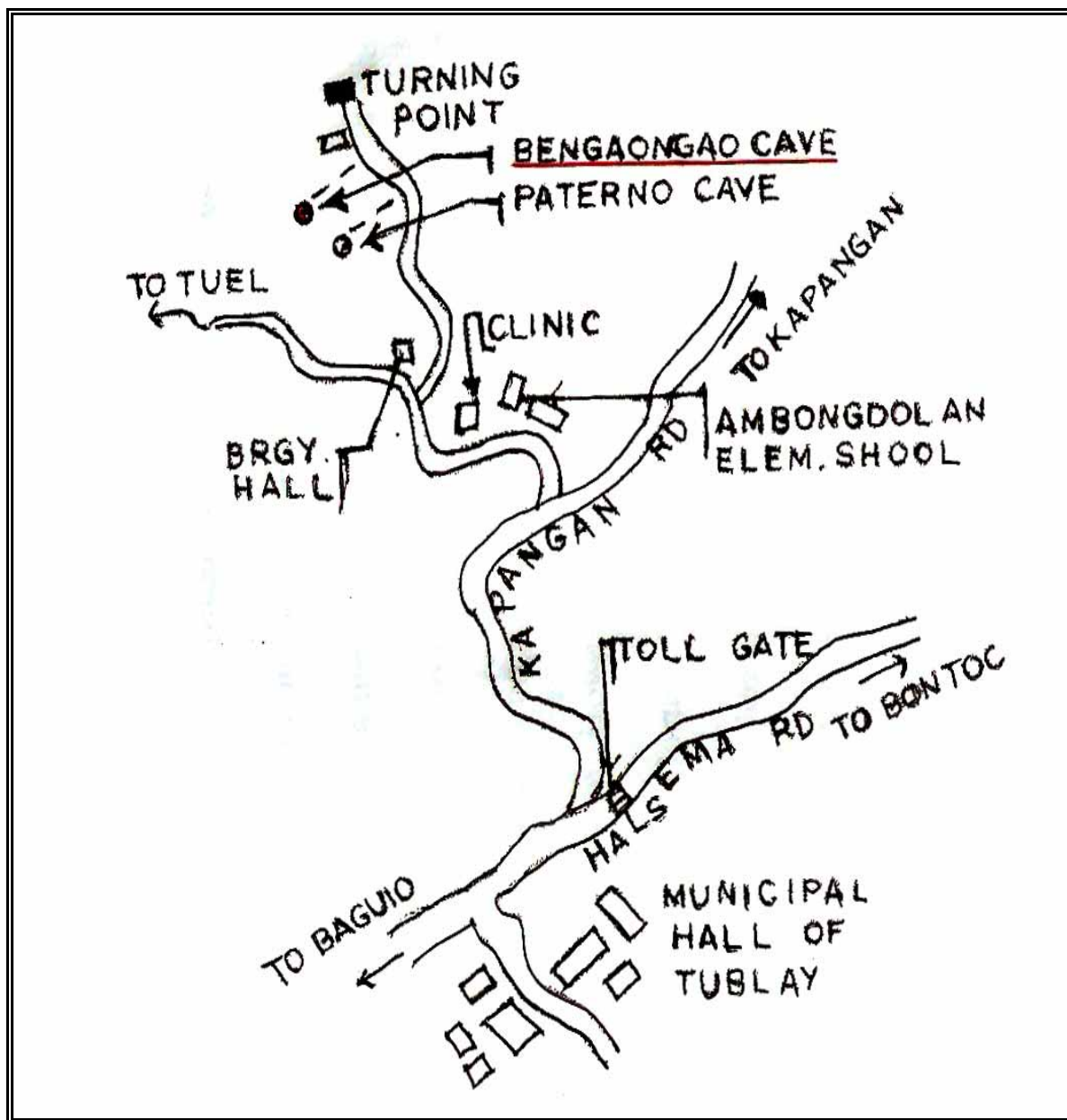




Source: Municipal Planning Development Office (MPDO), 2000.

Figure 2. Map of Barangay Ambongdolan, Tublay, Benguet.



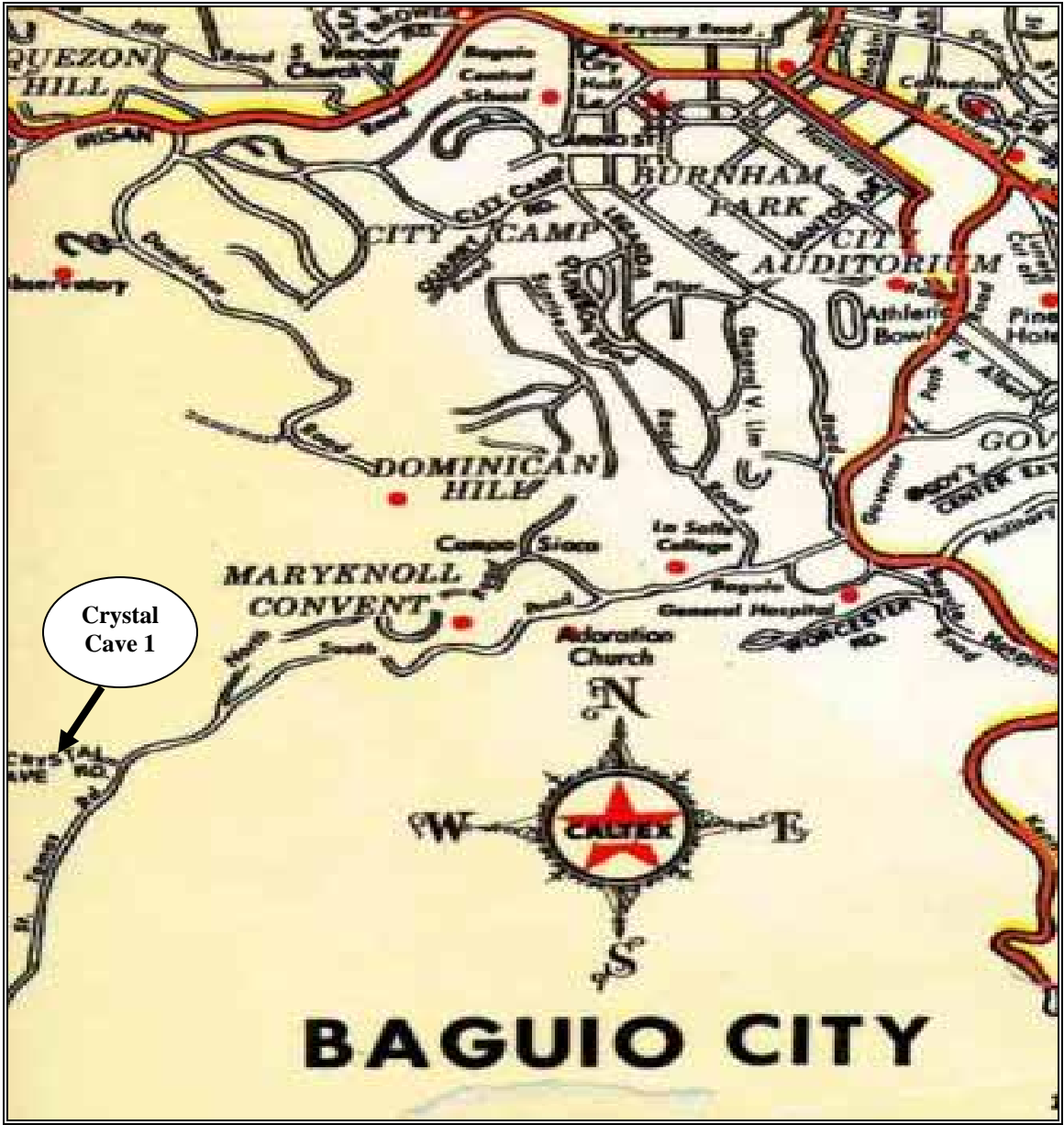


Source: Provincial Tourism Office of Benguet, No date.

Figure 3. Sketch map of Bengaongao cave, Ambongdolan, Tublay, Benguet.







Source: <http://www.gobaguio.com/maps.html>

Figure 4. Location map of Crystal Cave 1, Bakakeng Central, Baguio City





## REVIEW OF RELATED LITERATURE

### Physical Parameters

Total suspended solids. Total suspended solid (TSS) is a measure of the turbidity of the water. These are the solid materials from the natural and accelerated erosion from the land surfaces and clay deposits that are suspended in water (Kneese and Bower, 1984). Higher concentration of sediments causes the water to become turbid and can contribute to pollution that hinders some of the activities of aquatic life.

Water coming from the outside of the cave carry relative excessive amount of sediments, minerals and bacteria that ends up in the cave zone. These sediments can adversely affect the bottom habitats that serve as spawning areas for fishes. Furthermore, sediments carry nutrients and heavy metals that have adverse impact on the cave's water quality (Bahod et al., 2002).

Percent relative humidity and temperature. Humidity indicates the water vapor content of the atmosphere and strongly related to temperature. The amount of moisture that can be supported by the air depends directly on the temperature. At any given temperature either high or low, there is a limit to the amount of water vapor in which a given volume of air can absorb (Horrocks, 1981). According to the Ohio Caverns Inc. (2008), the humidity is very important to the cave environment, keeping it wet and allowing formations to grow.

Atmospheric conditions in the cave are generally uniform. At the entrance, temperature and humidity are in approximate surface conditions. Beyond a short zone of transition, temperature and humidity show little variation. The entrance of the cave is a variable-temperate zone which depends on the size and exposure of the entrance, volume



of air and water entering the cave, and extremes of seasonal temperature. Further inside the cave is the constant temperature zone wherein air and water temperature reach nearly complete stability, approximately uniform for the latitude and elevation of the cave. Cave humidity is close to 100 % except in some caves with abundant gypsum or other mineral deposits wherein humidity is low. The constant temperature of the cave allows the high humidity to be maintained indefinitely (Encyclopedia Americana, 1989). Brewer (1994) also mentioned that the cave physical environment is nearly constant – humidity is always high, while the temperature shows almost no day-to-night change and little seasonal variation, being near the average annual above ground temperature.

According to Wenger (1984) as cited by Bahod et al. (2002), temperature of water moderates the kind and quantity of organism present within the ecosystem. Smith (1980) as cited by Candiao et al., (2000) also added that the water having warmer temperature is more productive than water with cold temperature. Coker (1986) as cited by Balanggi et al. (2002) also mentioned that the temperature influences the physiological process in the bodies of aquatic animals. It may affect the rate of development and duration of the whole period of life as well as the size and form of aquatic individuals.

Substratum. Odum (1971) stated that the type of bottom, whether sand, pebbles, clay, bedrock, or rubble rock is very important in determining the nature of the communities and the population density of community dominants. Hard bottom, especially if composed of stones may offer favorable surfaces for both plants and animals to attach or cling. Sand or soft silt is generally the least favorable type of bottom which supports the smallest number of species and individuals of benthic plants and animals.



Clay bottom is more favorable than sand, flat or rubble rock generally produces the largest variety and highest density of bottom organisms.

McGeary and Plummer (1991) mentioned that the floors of most caves are covered with sediments, much of which is residual clay. When limestone-containing clay dissolves, the fine-grained particles left behind are called residues. Other sediments including the coarse-grained material found on cave floors maybe carried or drains into cave system from openings on the land surface.

### **Chemical Parameters**

Dissolved oxygen. According to Enger and Smith (1995), oxygen is important in water because it is used by the organisms for respiration and to break down organic compounds for different synthetic activities, growth and reproduction. Umaly and Cuvin (1988) as cited by Balanggi et al. (2002) added that solubility of oxygen also dependent on temperature and since biological oxidation rate increases with temperature, dissolved oxygen concentration may become critical under such conditions.

Mayer in 2001 stated that relatively high dissolved oxygen levels are beneficial to aquatic plants and animals that depend on aerobic respiration. Low DO levels are less beneficial and may fail to support aquatic life.

Hardness. Hardness is the characteristics of water which represents total concentration of calcium and magnesium ions in the water. Dissolved salts cause the hardness of water. The source of these salts is from rocks containing calcium or magnesium carbonates such as limestone ( $\text{CaCO}_3$ ) and dolomite ( $\text{CaCO}_3 \cdot \text{MgCO}_3$ ) (Williams, 2001).



pH. The alkalinity, acidity and neutrality of the water reflect to the CO<sub>2</sub> contents as well as the presence of organic acids and pollution (Smith and Smith, 1998). Odum (1971) also added that pH is a measure of productivity in aquatic ecosystems wherein water of low pH is quite frequently deficient in nutrients and low productivity. Lindsey (1981) as cited by Laguyo et al. (2001) stated that pure water has a pH of 7.0 representing neutrality of water. Value lower than 7.0 are indicative of acidic water, and values higher than 7.0 is alkaline water. Brewer (1994) also revealed that the water in caves tends to be hard and alkaline.

### **Biological Components of the Cave**

Macroscopic organisms. Some life forms can be found outside and around the entrance of caves. Birds rest in rocks and crannies of the rocks. Deer browse near the entrance. Bats can be found hanging from the ceiling near the entrance of the cave but can be found deep inside the cave. Some of the creatures are found in the depths of the cave where no natural light ever penetrates such as millipedes, fishes and salamanders (Dumas, no date). These species have been isolated from the surface environment for many thousand of years. They are blind and albinos which means that their skin pigmentation is not maturely produced and they are often pink or white. However, they have adapted a mutation for coloration (Chadick, no date). These bats, the most unloved and widely misunderstood among forest creatures, play an important role in the seed from the fruits and carry them off to spread on the floor of the forest (La Corte, 2008).

Cave creatures tend to be small and slender with thin pale body coverings. Surrounded by high humidity, they need no special hair or scales to hold or repel



moisture. They have no use for eye evolving instead long organs of touch and a sharp sense of smell for locating sparse food (Aldrich et al., 2002) as cited by Bahod et al., (2002). Anonymous (2001) as cited by Bahod et al. (2002) added that some of the cave dwelling creatures depend on smell, whereas many of them have evolved adaptations to afford a better sense of touch.

Chadick (no date) also mentioned that plants such as mosses and ferns grow in wet places near the caves. Small green algae grow on the rocks. Because green plants must use the sunlight to carry out the process of photosynthesis, there are no plants deep inside the cave. Brewer (1994) added that the cave ecosystem, thus, is heterotrophic. Food chains are based on energy brought from outside in which this start from bacteria and scavengers.

### **Cave Management**

Caves contain beautiful and unique mineral formations. Some caves contain rare and endangered species. Yet, these fragile formations are very susceptible to damage. Cave formations, once damaged, almost never grow back and damaging or removing such features is like tearing out a page from a historic document (The Mother Lode Grotto of National Speleological Society, 2007).

Anonymous (2004) stated that caving involved a sense of responsibility and conservation. Caves and their formations take hundreds to thousands of years to form. Responsible cavers never purposefully break formations or remove them as souvenirs and no staining on rock formations and cave walls.



Under Republic Act No.9072 which is known as the National Caves and Cave Resources Management and Protection Act, it states that caves and cave resources as parts of the country's natural wealth should be conserved, managed and protected through cooperation and exchange of information between governmental authorities and people who utilize caves and cave resources for scientific, recreational; tourism, and other purposes.

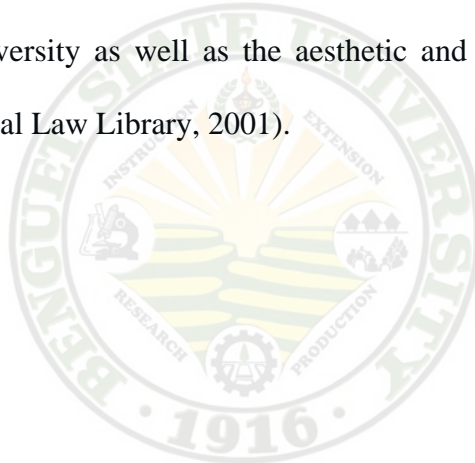
Section 7 of R.A. 9072 is the prohibition act which includes a) knowingly destroying, disturbing, defacing, marring, altering, removing, or harming the speleogem or speleothem of any cave or altering the free movement of any animal or plant life into or out of any cave; b) gathering, collecting, possessing, consuming, selling, bartering or exchanging or offering for sale without authority any, cave resources; and c) counseling, procuring, soliciting or employing any other person to violate any provision of this Section.

Section 8 of this Act stated that any person found guilty of any of the offenses enumerated under Section 7 hereof shall be punished by imprisonment from two (2) years to six (6) years or a fine ranging from Twenty thousand pesos (PhP 20,000.00) to Five hundred thousand pesos (PhP 500,000.00) or both at the discretion of the court. Provided, that the person furnishing the capital to accomplish the acts punishable herein shall be punished by imprisonment from six (6) years and one (1) day to eight (8) years or by a fine ranging from Five hundred thousand pesos (PhP 500,000.00) to one (1) million pesos (PhP 1,000,000.00) or both at the discretion of the Court. Provided further, that if the area requires rehabilitation or restoration as determined by the Court, the defender shall also be required to restore the same, whenever practicable, or compensate for the damage.



Provided, finally, that if the offender is a government employee, he or she likewise be removed from office.

In the implementation, the DENR (Department of Environment and Natural Resources ) shall formulate, develop and implement a national program for the protection and conservation of the caves and caves resources; disseminates information and conduct educational campaign in the need to conserve, protect and manage our caves and resources; and to issue permits for the collection and removal cave resources in coordination with the DOT (Department of Tourism), national museum, concerned LGU's (Local Government Units), scientific community and the residence, taking into consideration the biodiversity as well as the aesthetic and archeological value of the areas (Chan Robles Virtual Law Library, 2001).





## METHODOLOGY

### Methods

Sampling zones. There were three (3) sampling zones (Z) established in Bengao-  
ngao cave and Crystal cave 1. One was located near the entrance (Zone 1), the second  
sampling zone was established in the twilight zone (Zone 2) and the third was at the dark  
zone (Zone 3) of the caves. Each zone was subdivided into three substations (S), namely  
S1, S2, and S3 with an interval of 2.5 meters as shown in Figure 5 and 6.

Collection and testing of water samples. Temperature, percent relative humidity,  
substratum and pH analyses were done on site. There were three trials made for  
temperature and pH in each zone which was collected from the substations. While  
percent relative humidity and substratum was determined particularly in S2 of each zone.

For the Dissolved Oxygen (DO), Total Suspended Solids (TSS), and hardness  
analyses, composite water sampling was done in each zone. The DO analysis was done  
on site. while the TSS and hardness analysis, water samples were brought to the Biology  
Laboratory at Benguet State University, La Trinidad, Benguet and DOST Laboratory, La  
Trinidad, Benguet for the tests, respectively.

Physical characterization. For the physical parameters, the following analyses  
were done:

A. *Total suspended solids (TSS).* Data for suspended solids were obtained by  
collecting a liter of water sample in each zone (Zone 1 and Zone 3) through composite  
water sampling (S1, S2 and S3). The water samples were brought to the Biology  
laboratory and were filtered using the pre-weighed air dried filter paper.





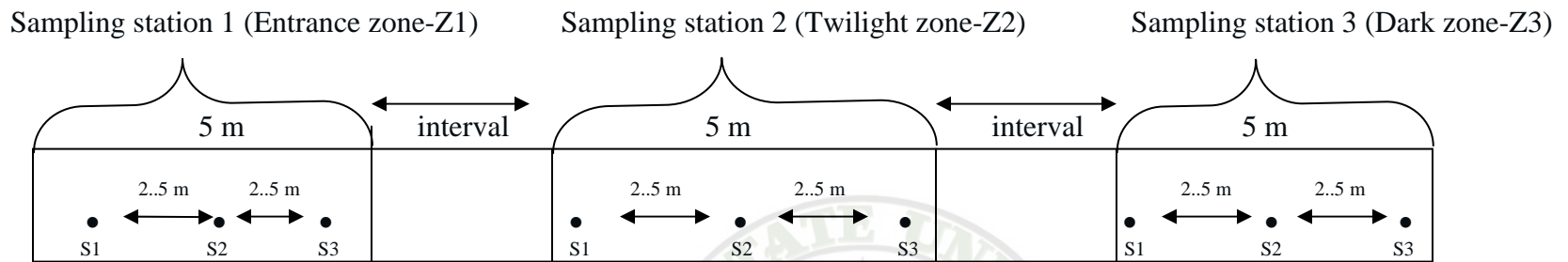


Figure 5. Sampling station in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

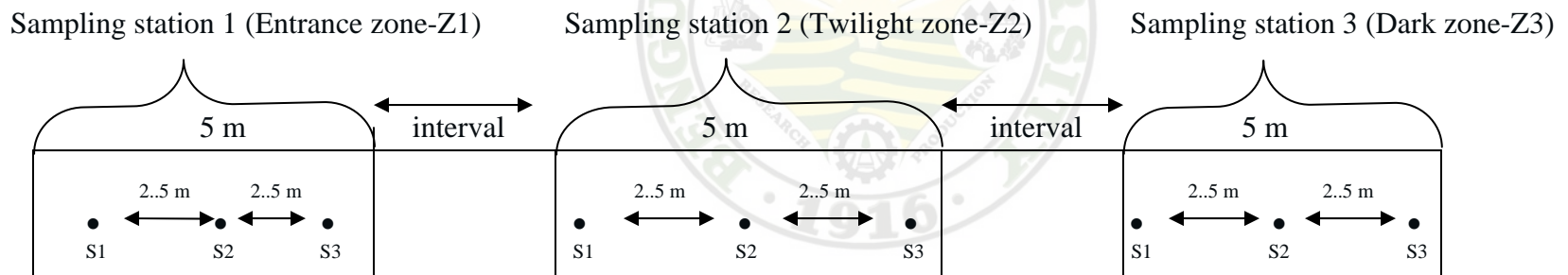


Figure 6. Sampling station in Crystal Cave 1, Bakakeng, Central, Baguio City



The paper together with the residues was air dried and was weighed again to determine the weight change. The TSS was determined using this formula:

TSS= air-dried weight of filter paper and residue – initial weight of filter paper.

*B. Percent relative humidity.* The Dry and Wet Bulb Sling Psychrometer was used in determining the humidity of each zone particularly in S2. The wet bulb thermometer covered with wet cloth was whirled and was read afterwards. The dry bulb thermometer was also read after reading the wet bulb thermometer. The difference between the dry and wet bulb reading which gives the percent relative humidity of the cave was identified with the aid of the psychometric table.

*C. Temperature.* The range of air, surface water and under water temperature of each substation was determined. Air temperature was obtained by suspending the thermometer twenty (20) centimeters above the water surface. Surface water temperature was determined by dipping the thermometer five (5) centimeters from the surface water. Underwater temperature was taken by submerging the thermometer at a depth of between the surface and substratum. Three (3) trials were done in every zone for three minutes.

*D. Substratum.* The substrata of the three zones were determined by scooping a sample from S2 of each zone and applying the “feel” method to know if it is rocky, clayey, sandy or silty. Rocky substrata have the presence of gravel that ranges from 2.0 cm and or above diameter; clayey has smooth, sticky and plastic-like texture; sandy has gritty or rough texture; and the silty substrata have smooth and powdery texture.



Chemical characterization. For the chemical parameters, the following were done:

*A. Dissolved oxygen (DO).* Data for dissolved oxygen were determined by collecting a liter of water sample in each zone (Zone 1 and 3) through composite water sampling (S1, S2 and S3). The water samples were analyzed using the Hanna Dissolved Oxygen Test Kit. The mean dissolved oxygen of each study site was computed by taking the summated values and dividing it by two.

*B. Hardness.* Data for hardness were determined by collecting a liter of water sample in each zone (Zone 1 and Zone 3) through composite sampling. The water samples were brought to the DOST, La Trinidad, Benguet for laboratory analysis. The mean dissolved oxygen of each study site was computed by taking the summated values and dividing it by two.

*C. pH.* The alkalinity, acidity or neutrality of the water were determined by using the mean Hanna pHep pocket – sized pH which was dipped in each sampling sites (S) of each zone (Zone 1 and Zone 3). The mean pH of each study site was computed by taking the summated values and dividing it by six.



Biological characterization. Macroscopic flora and fauna were determined through plot method. Three 1 m by 1 m was randomly laid out in each sampling zone. Organisms found within the plot were identified and counted while highly motile species found outside the plots including aerial species were only identified and listed. Macroscopic flora and fauna were identified by their scientific and/or local names.

Importance value and biodiversity indices were calculated using the following formula:

a. Density ( $D_i$ ) =  $\frac{\text{Total number of individuals per species } (n_i)}{\text{Total sampled area (TSA)}}$

b. Frequency ( $F_i$ ) =  $\frac{\text{Number of plots where a certain species occur } (J_i)}{\text{Total number of plots sampled } (K)} \times 100$

c. Relative Density ( $RD_i$ ) =  $\frac{(D_i)}{(\sum D)} \times 100$

d. Relative Frequency ( $RF_i$ ) =  $\frac{(F_i)}{(\sum F)} \times 100$

e. Importance Value ( $IV_i$ ) =  $\frac{RD_i + RF_i}{2}$

f. Species Diversity Index: Shannon Weiner Diversity Index ( $H'$ )

$$H' = -\sum (n_i/N) \log (n_i/N)$$

Where in:  $n_i$  = number of individuals

$N$  = total number of individuals

$$H' \text{ max} = \log S$$

Where  $S$  = total number of species

Evenness ( $J$ )

$$J = \frac{H'}{H' \text{ max}}$$



Management practices. A semi-structured questionnaire/interview guide (Appendix D) was used as a primary instrument in attaining the information about the management practices employed to Bengao-ngao cave and Crystal cave 1. There were 15 respondents in each study site. These respondents were purposively selected from the residents with 10 years residential period. Five of the respondents came from the elders, another five from the tour guides or residents and five from the barangay officials.

### **Data Gathered**

The data gathered include the physical, chemical and biological parameters of the two caves. The physical parameters include total suspended solids, percent relative humidity, temperature and substratum. In terms of chemical parameters, the DO, hardness and pH were also collected. For the biological parameters, macroscopic flora and fauna found inside the caves were included. Moreover, the cave management practices employed by the residents at Bengao-ngao cave and Crystal cave 1 were determined.

### **Statistical Analysis**

The data were consolidated, tabulated, interpreted and analyzed using the help of some appropriate statistical tools such as mean that was used to determine the differences between the physical and chemical parameters of the two caves. Mean was obtained using this formula:

$$X = \frac{\sum xi}{N}$$

Where: X is the mean



$\sum x$  is the mean of the measures

N is the number of trials

Likewise, the importance value, species diversity (Shannon Weiner Diversity Index) indices were used to compare the biological components (macroscopic organisms) of the two caves. Moreover, frequency counts, percentage and Likert scale rating were used to record the responses of the respondents towards the management of the two caves. Likert scale rating was obtained using the following formula.

$$\text{Weighted mean (x)} = \frac{\sum_{i=1}^n W_i X_i}{\sum_{i=1}^n W_i}$$

Where: W is the number of response

X is the number of scale



## RESULTS AND DISCUSSION

### Physical Parameters

*a) Total suspended solids (TSS).* Table 1 presents the mean physical characteristics of Bengao-ngao Cave and Crystal Cave 1. As shown in Table 1, the mean Total Suspended Solids of the water in Bengao-ngao Cave was 50 mg/L. Bengao-ngao Cave registered a very low value of TSS because it is located in a forested area and away from man's activities (Appendix Plate 1). Crystal Cave 1, on the other hand, has no data on TSS since there is no water during the time of the study because it is usually being drained due to its polluted status (Table 13) and for the accessibility of the tourists during their visits.

*b) Percent relative humidity (%RH).* Bengao-ngao Cave registered a mean percent relative humidity of 90 while Crystal Cave 1 registered 84.33 (Table 1). The high humidity of Bengao-ngao Cave may be attributed to the presence of water. Consequently, moisture seeps through the ceiling, wall and floor of the cave. The finding corroborates with the statement of the Crystal Cave Organization (2009) that the high humidity in the cave is due to the moisture seeping through the ceiling, wall and floor of the cave. Thus, the lower mean percent relative humidity of Crystal Cave 1 is probably due to the absence of water in the cave. As mentioned earlier, the water is being drained off by the tour guides because it is polluted and it is for the accessibility of the tourists in Crystal Cave 1.



Table 1. Mean physical parameters of Bengao-ngao Cave and Crystal Cave 1.

Physical Parameters		Bengao-ngao Cave	Crystal Cave 1
Total Suspended Solids (mg/L)		50	-
% Relative Humidity		90	84.33
Temperature range (°C)			
• Air temperature		17 – 24	15 – 17
• Surface water temperature		15 – 23	-
• Under water temperature		23 – 23.5	-
Substratum		Rocky and sandy	Rocky and muddy

\*Legend: no data (-)

**c) Temperature.** Bengao-ngao Cave had a higher value of air temperature which ranges from 17°C – 24°C while Crystal Cave 1 had 15°C - 17°C (Table 11). The cave temperatures may be attributed to their locations. The temperature of Bengao-ngao cave is very close to the Benguet mean air surface temperature of 19.4°C (Socio-Economic Profile of Benguet, 2007). The air temperature of Crystal Cave 1, on the other hand, is close to Baguio City's air surface temperature of 18.3°C (PAG-ASA-DOST, no date). This finding is supported by Encyclopedia Americana (1989), which stated that most of the time, the temperature of the cave is close to the mean annual or surface temperature of the region where the cave is located.

Table 1 also presents the surface water temperature of Bengao-ngao Cave which ranges from 15°C - 23°C and the under water temperature which ranges from 23°C – 23.5°C. The results imply that the surface water temperature is colder than that of the under water temperature.

**d) Substratum.** Table 1 also shows the substratum of Bengao-ngao Cave, which is rocky (Zone 1 and Zone 3) (Appendix Plate 4), and sandy (Zone 2); and Crystal Cave 1 which has a rocky and muddy substratum from zones 1 to 3 (Appendix Plate 5).





The predominated rocky substratum of Bengao-ngao Cave is due to the fact that the cave has preserved its stalagmite. The sandy substratum in zone 2 may be attributed to its flat terrain allowing the sand carried by the water that flows through the cave to settle down.

Crystal Cave 1, on the other hand, has a rocky and muddy substratum. The presence of mud throughout the cave zones may be attributed to the soil particles carried by run-off that flows into the cave during rainy season. Moreover, the cave serves as a receiving body of the liquid and solid wastes by the surrounding residential and commercial (drying and packing of smoked fish or “*tinapa*”) areas especially during rainy season (Appendix Plate 3).

As mentioned by McGeary and Plummer (1991), the floors of most caves are covered with sediments, much of which is residual clay. When limestone-containing clay dissolves, the fine-grained particles left behind are called residues. Other sediments including the coarse-grained material found on cave floors carried or drains into cave system from openings on the land surface.

### **Chemical Parameters**

*a) Dissolved oxygen (DO).* Table 2 shows the chemical parameter of Bengao-ngao cave. As shown in the table, the mean amount of dissolved oxygen of Bengao-ngao cave was 5.25 mg/L. This implies that the water in Bengao-ngao cave is clean and able to support living organisms.



Table 2. Mean chemical parameters of Bengao-ngao Cave.

Chemical Parameters	Bengao-ngao Cave
Dissolved Oxygen (mg/L)	5.25
Hardness (mg/L)	154
pH	7.99

**b) Hardness.** Bengao-ngao Cave has a mean hardness of 154 mg/L (Table 2), which is hard water. In the Philippine Standards on hardness of water, value ranging from 150-300 mg/L is hard water. Brewer (1994) also said that water in caves tends to be hard. The rocky substratum of the cave could be an evident of hard water in the two caves. The source of hardness in water according to Williams (2001) is from the rocks containing calcium or magnesium carbonates such as limestone and dolomite.

**c) pH.** Bengao-ngao Cave registered a mean pH value of 7.99 (Table 2) which is indicative of alkaline water. This corroborates with the statement of Brewer (1994) that water in caves tends to be alkaline. The alkalinity of the water in the cave could be associated to the presence of calcium and magnesium ions in the water caused by rocks present in the cave. These ions do not only cause hardness of water but it also is a good source of alkalinity of water.

Crystal Cave 1, on the other hand, has no data on DO, hardness and pH because there is no water during the time of the study. The water is usually being drained due to its polluted status (Table 13) and for the accessibility of the tourists during their visits.

### Biological Parameters

**a) Macroscopic flora.** Table 3 shows that the plant species that predominate in Bengao-ngao Cave is the *Sphagnum sp.* (moss), with an importance value of 46.86 % followed by wild gabi (*Taenitis luzunica*) or *pehaw* in *Ibaloi* term (Appendix Plate 6)



Table 3. Floral diversity in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City.

<b>BENGAO-NGAO CAVE</b>			
Species Name	Ni	Importance Value (%)	Rank
Moss ( <i>Sphagnum sp.</i> )	295	46.86	1
Maidenhair fern ( <i>Adiantum capillus-veneris</i> Linn.)	76	13.10	3
Fern (endemic) ( <i>Cheilanthes dilimanensis</i> )	15	6.23	4
Pekaw /wild gabi ( <i>Taenitis luzonica</i> )	55	19.83	2
Sipa-sipa ( <i>Ageratina riparia</i> )	1	4.66	5
Copdas /gipah tea ( <i>Sarrandra glabra</i> )	1	4.66	5
“Ap-pas”	1	4.66	5
<b>TOTAL</b>	<b>444</b>	<b>100</b>	

<b>CRYSTAL CAVE 1</b>			
Species Name	Ni	Importance Value (%)	Rank
Gabi/Taro ( <i>Colocasia esculenta</i> Linn.)	2	23.61	2
Angels trumpet ( <i>Datura innoxia</i> )	7	76.39	1
<b>TOTAL</b>	<b>9</b>	<b>100</b>	

with 19.83% then by maidenhair fern (*Adiantum capillus-veneris* Linn.) (Appendix Plate 7) with 13.10 %, respectively. *Cheilanthes dilimanensis*, which is an endemic fern, was also found in Bengao-ngao Cave having an importance value of 6.23%. The least dominant species in the cave were the sipa-sipa (*Ageratina riparia*), *copdas/gipah* tea (*Sarrandra glabra*) (Appendix Plate 8), and “ap-pas” (Appendix Plate 9) with 4.66%. All these floral species were found at the entrance zone of the cave. According to the Encyclopedia Americana (1999), growth of plants in the cave is restricted to the twilight zone because green plants must use the sunlight to carry out the process of photosynthesis.

Crystal cave 1, on the other hand, consisted of only two floral species which were found in the twilight and dark zones of the cave. These included the angels trumpet



(*Datura innoxia*) (Appendix Plate 10) having an importance value of 76.39% and gabi (*Taenitis luzonica*) (Appendix Plate 11) with 23.61%. The floral species found in the twilight and dark zones, which are pale green due to lack of sunlight, are probably the plants that were planted in the surrounding area (Appendix Plate 3) and were carried into the cave by run-off. According to Chadick (no date), there were no plants deep inside the cave. However, these plants may be carried by the water flowing into the cave.

### ***b) Macroscopic fauna***

*b.1. Macroscopic fauna species within the sampling plots.* Table 4a shows that Bengao-ngao Cave is predominated by black ants with an importance value of 69.45%. The second dominant species is the moth with 11.11% importance value, followed by the spider and cave beetle with 9.72%, respectively. Crystal Cave 1, on the other hand, has no animal species present on each sampling plot of each sampling zone.

*b.2. Macroscopic fauna species outside the sampling plots.* There were also identified aerial and highly motile species found in the caves (Table 4b). Results showed that there were higher number of aerial and motile species (5) identified in Bengao-ngao Cave than in Crystal Cave 1 (3). Aerial species such as bats and “*pipingew*” and motile species such as cave cricket (Appendix Plate 12) and cave frog (Appendix Plate 13) are only found in Bengao-ngao cave. This implies that the cave especially the Bengao-ngao Cave houses very unique and important faunal species. This also indicates that the Bengao-ngao Cave has a clean environment that attracts aerial species especially since it is located in a forested area. In contrast with Crystal Cave 1, the presence of mosquitoes and cluster flies would mean that the cave has a dirty environment. Only the



Table 4b. Aerial and highly mobile faunal species found outside the sampling plots in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City.

Common Name	Bengao-ngao Cave	Crystal Cave 1
Bats	/	X
<i>Pipingew</i>	/	X
Cave Spider	/	/
Cave Cricket	/	X
Cave Frog	/	X
Cluster Flies	X	/
Mosquitoes	X	/

\*Legend: / - Present

X - Absent

cave spider (Appendix Plate 14) which is found in both caves, are natural inhabitants of the cave.

### c) Diversity index

*c.1. Floral diversity index.* As to the Shannon Weiner Diversity Index, Bengao-ngao Cave is more diverse than Crystal Cave 1 as shown by its higher value of diversity index (0.43) and species richness (7) with 444 individuals (Table 5). Crystal Cave 1, however, has a higher value of evenness which is 0.76. The result of the study corroborates with the study of Ponce (1995) as cited by Albo et al. (2003), which stated that, communities having abundant species will have high species diversity. This also implies that Bengao-ngao Cave is much stable than that of the Crystal Cave 1. According to Odum (1971), the stability of ecosystem is directly correlated to diversity than that of productivity.



Table 5. Floral diversity indices of the two caves.

MEASURE	BENGAO- NGAO CAVE	CRYSTAL CAVE
Total number of species (S)	7.00	2.00
Total number of individuals (N)	444.00	9.00
Shannon Weiner Index (H')	0.43	0.23
H' max	0.84	0.30
Evenness (J)	0.51	0.76

*c.2. Faunal diversity index.* Table 6 shows that Bengao-ngao Cave has a faunal species diversity index of 0.23, species richness of 4 with a total number of 37 individuals and an evenness of 0.39. Unfortunately in Crystal Cave 1, there had been no animals found in each sampling plots of each zone. This only means that Bengao-ngao cave, as an ecosystem, is also more diverse in faunal species than Crystal Cave 1.

Table 6. Faunal diversity indices in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

MEASURE	BENGAO-NGAO CAVE
Total number of species (S)	4.00
Total number of individuals ( N)	37.00
Shannon-Weiner Index (H')	0.23
H' max	0.60
Evenness (J)	0.39





## Demographic Profile of the Respondents

Table 7 reflects the demographic profile of the respondents in Ambongdolan, Tublay, Benguet and Crystal Cave, Bakakeng Central, Baguio, City. The ages of the respondents in Barangay Ambongdolan, Tublay, Benguet range from 26-69 years old where 40% and 33% are within the age range of 26-36 and 37-47, respectively. In Crystal Cave, the respondents' ages range from 15-69 years old, 33% of which are within the age range of 48-58 years old. This implies that the respondents are mature. In line with their ages, majority of the respondents in Ambongdolan, Tublay live in the area for more than 26 years while the respondents in Crystal Cave, Bakakeng Central, Baguio City live in the area for more than 15 years. Thus, they are capable of comparing the past, which is about ten years ago, and present situation of the caves.

Respondents in Barangay Ambongdolan have almost equal distribution in terms of gender, 53% are female and 47% are male but in Purok Crystal Cave, a great percentage (80%) are female because majority of the male are working in the city while the females usually stay at home thus, they are more available to serve as tour guides than males within the area. In Barangay Ambongdolan, 20% of the respondents are elementary graduate, 27% are high school undergraduate, 40% are high school graduate, and 13% of the respondents are college graduate. In Purok Crystal Cave, 13% of the respondents are elementary undergraduate, 13% are high school undergraduate, 20% are high school graduate, 20% are college undergraduate, and 33% of the respondents are college graduate. This implies that all of the respondents within the two barangays are all literate. In Barangay Ambongdolan, 40% of the respondents are barangay officials, 33% are tour guides, and 27% are farmers while in Purok Crystal Cave, only 7% of the respondents are



Table 7. Demographic profile of the respondents in Ambongdolan, Tublay, Benguet and Crystal Cave, Bakakeng Central, Baguio, City (N=15).

Characteristics	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Frequency	Percentage (%)	Frequency	Percentage (%)
<b>Age bracket</b>				
15-25	0	0	4	27
26-36	6	40	4	27
37-47	5	33	1	7
48-58	3	20	5	33
59-69	1	7	1	7
<b>Number of years staying in the area</b>				
>10-<15	0	0	3	21
15-25	1	7	7	50
26-36	7	47	1	7
37-47	3	20	2	7
48-58	3	20	1	7
>58	1	7	1	7
<b>Gender</b>				
Male	7	47	3	20
Female	8	53	12	80
<b>Educational attainment</b>				
Elementary graduate	3	20	0	0
Elementary undergraduate	0	0	2	13
High school graduate	6	40	3	20
High school undergraduate	4	27	2	13
College graduate	0	0	5	33
College undergraduate	2	13	3	20
<b>Occupation</b>				
Barangay official	6	40	1	7
Tour guide	5	33	7	47
Farmer	4	27	0	0
Residents	0	0	6	40
Mining engineer/DENR officer	0	0	1	7





barangay officials and mining engineer/DENR officer, 47% are tour guides, and 40% are residents. A great number of barangay officials were interviewed in Barangay Ambongdolan since it was also found out that they are part of the cave management in contrast with the barangay officials of Crystal Cave that they are not directly involved in the management.

## Management Practices

### *a) Cave assessment by the respondents*

*a.1. Past situation of the cave.* The past situation of Bengao-ngao Cave in Ambongdolan, Tublay, Benguet and Crystal Cave 1 in Crystal Cave, Bakakeng Central, Baguio City is shown in Table 8. For the past 10 years or so, the rock formations (stalactites, stalagmites and flowstones), water quality, and plants and animals inside and outside the caves are still in very good and good conditions especially in

Table 8. Assessment of the past situation of the two caves (N=15)

Cave characteristics	Bengao-ngao Cave		Crystal Cave 1	
	Weighted Mean	Description	Weighted Mean	Description
<b>Within the cave</b>				
Rock formation				
Stalactites	3.60	Very good	3.47	Very good
Stalagmites	3.60	Very good	3.00	Good
Flowstones	3.73	Very good	3.30	Very good
Water quality	3.54	Very good	3.46	Very good
Plants	3.00	Good	3.08	Good
Animals	3.67	Very good	2.92	Good
<b>Outside the cave</b>				
Plants	3.93	Very good	2.93	Good
Animals	3.71	Very good	2.60	Good
Statistical limit	Descriptive Equivalent:			
3.25-4.0	Very good (76-100% of the cave is preserved)			
2.5-3.25	Good (51-75% of the cave is preserved)			
1.75-2.5	Fair (26-50% of the cave is preserved)			
1.0-1.75	Poor (0-25% of the cave is preserved)			



Ambongdolan Cave, which means that almost all of the natural resources of the cave are beautifully intact or preserved.

*a.2. Present situation of the cave.* At present, however, the Crystal Cave 1 (Table 9), alteration or destruction of resources in the cave is very noticeable and rampant. Almost all of the natural resources in the said cave are poorly preserved or managed as reflected by its bio-physico-chemical characteristics. There are no stalagmites found inside the Crystal Cave anymore. The stalactites and the flowstones (Appendix Plate 30-36) turned black probably because the cave tourist guides use torch (“*saleng*”) as source of light during touring. This corroborates with the perception of the respondents that the rock formations are fairly or poorly preserved. There are only rock formations that can be seen inside and were perceived by the respondents to be fairly and poorly preserved and managed. There were almost no animals and plants that can be found both inside and outside the cave since the cave is now surrounded by many houses and the area is highly urbanized already. In contrast with Bengao-ngao Cave where there is no relative difference from the past to present situation except for the preservation of animals inside the cave which was altered from very good to good and the preservation of both animals and plants outside the cave which were also altered from very good to good. The community was still able to preserve most of the resources of the cave even up to the present. This is probably because it is located in a forested area and away from man’s activities. Furthermore, there is a strict implementation of rules and regulations so as to protect the cave.



Table 9. Assessment of the present situation of the two caves (N=15)

Cave characteristics	Bengao-ngao Cave		Crystal Cave 1	
	Weighted Mean	Description	Weighted Mean	Description
<b>Within the cave</b>				
Rock formation				
Stalactites	3.33	Very good	1.93	Fair
Stalagmites	3.33	Very good	1.40	Poor
Flowstones	3.57	Very good	1.45	Poor
Water quality	3.38	Very good	1.13	Poor
Plants	2.58	Good	1.21	Poor
Animals	2.58	Good	1.31	Poor
<b>Outside the cave</b>				
Plants	3.21	Good	1.29	Poor
Animals	2.79	Good	1.33	Poor
Statistical limit	Descriptive Equivalent:			
3.25-4.0	Very good (76-100% of the cave is preserved)			
2.5-3.25	Good (51-75% of the cave is preserved)			
1.75-2.5	Fair (26-50% of the cave is preserved)			
1.0-1.75	Poor (0-25% of the cave is preserved)			

### ***b) Issues and concerns about the caves***

*b.1. Problems encountered in the two caves.* Table 10 shows the problems being encountered within the cave and its environment. In Bengao-ngao Cave, problems such as improper liquid waste management, improper solid waste management, collection of crystalline, collection of plant specimens, collection of animal species, use of light source such as “saleng”, gas lamp, etc., and accidents/illness/lost or disappearance of visitors perceived to be not severe since all tourists who visited the cave were properly organized and oriented by the tour guides and that all of the residents were also actively participating in the cave management. In Crystal Cave 1, however, because of the poor management and participation of the residents and since it is located in highly urbanized area, problems such as improper solid and liquid waste management were perceived to be very severe.



Table 10. Problems encountered within the cave and its environment (N=15)

Problems	Bengao-ngao Cave		Crystal cave 1	
	Weighted mean	Description	Weighted mean	Description
Improper liquid waste management	1.09	Not severe	3.73	Very severe
Improper solid waste management	1.50	Not severe	3.33	Very severe
Collection of crystalline	1.67	Not severe	2.20	Slightly severe
Collection of plant specimens	1.33	Not severe	2.60	Moderately severe
Collection of animal species	1.00	Not severe	2.20	Slightly severe
Use of light source such as “ <i>saleng</i> ”, gas lamp, etc.	1.13	Not severe	2.64	Moderately severe
Vandalizing	1.90	Slightly severe	2.67	Moderately severe
Accidents/illness/loss or disappearance of visitors	1.38	Not severe	1.25	Not severe
Statistical limit	Description			
3.25-4.0	Very severe (76-100% of the problems were encountered)			
2.5-3.25	Moderately severe (51-75% of the problems were encountered)			
1.75-2.5	Slightly severe (26-50% of the problems were encountered)			
1.0-1.75	Not severe (0-25% of the problems were encountered)			

Problems on collection of plant species, use of “*saleng*” or gas lamp and vandalizing are moderately severe while collection of crystalline rock and animal species are slightly severe. According to one barangay official, the reason why there is a big problem in the solid and liquid waste of Purok Crystal Cave, Bakakeng Central, Baguio City is that the residents in the area are very hard headed, even with a simple garbage segregation, residents do not abide with it. Moreover, residents in Purok Crystal Cave just dispose their wastes especially their liquid wastes which goes directly to the cave because the elevation of the cave is lower than the elevation of the houses near the cave. This is the reason why the water quality of the cave was very poor and that managers of the cave have to drain the water inside the cave. The use of “*saleng*” as a source of light in



entering the cave was moderately severe since the tour guides and managers of the cave are now starting to use flashlights in entering the cave. The use of “*saleng*” as a source of light in entering the cave is a problem in the cave because “*saleng*” produces black soot which makes the ceiling and surroundings of the cave colored black causing the degradation of the cave. According to the tour guides, accidents, illness, or lost/disappearance of visitors within the cave were not severe because the cave is not too long to traverse. It only takes less than an hour to tour the cave. Moreover, they do not limit the numbers of tourists entering the cave. About 30 tourists may enter the cave even at the same time. In Bengao-ngao Cave, even when touring takes more than an hour because the cave is too long and has many passages, accidents, illnesses, or lost/disappearance of visitors are not severe as well since tour guides limit the number of tourists entering the cave to 5 people per tour guide. This is to ensure that the tour guides can properly handle/or to have a closer look over the tourist being guided.

*b.2. Non-participation of the community to cave management.* In connection with the management practices being implemented in the two different caves, perceptions of the community towards their participation in the cave management is shown in Table 11. In Barangay Ambongdolan, 87% of the respondents said that destruction of rock formations and alteration of plant and animal life found inside and outside the cave would occur if the community would not participate. While 60% of the respondents added that cave water may be polluted. However, because of the presence of active community participation and strict implementation of rules and regulations on the preservation of Bengao-ngao cave, the residents are confident that the above problems will not happen.



Table 11. Perceptions of the community if they will not participate in the cave management (N=15)

Perceptions	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Destruction of rock formations	13	87	15	100
Alteration of plant and animal life found inside and outside the cave	13	87	8	53
Pollution of the cave water	9	60	15	100
Garbage problem/flooding of the area	0	0	1	7

In Purok Crystal Cave, on the other hand, 100% of the respondents said that there would be further destruction of rock formations and pollution of the cave water if the community would not participate in the management of the cave. A majority of the respondents (53%) also said that there would be further alteration of plant and animal lives both found inside and outside the cave. Seven percent (7%) of the respondents added that improper garbage disposal would cause flooding in the area. Unfortunately, these perceptions in Crystal Cave 1 were already experienced because of poor management and lack of community participation and cooperation. Crystal cave's water is already polluted because of household wastes, rock formations were destroyed because of the use of "saleng" as a light source and wastes carried by the water that enters the cave, and the plants and animal life found inside and outside the cave were already altered.

### ***c) Management proper***

*c.1. Cave utilization.* Both caves are used for ecotourism purposes as shown in Table 12. However, in Purok Crystal Cave, the cave is being utilized in the context of "tourism" which means that the cave is for generating income only and not in





Table 12. Cave utilization in the community (N=15)

Cave utilization	Bengao-ngao Cave		Crystal Cave 1	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Ritual purposes	0	0	3	20
Habitat for plants and animal life	13	86.67	1	6.67
Recreational purposes	10	66.67	3	20
Educational purposes	14	93	4	26.67
Ecotourism	15	100	15	100

the context of “ecotourism” that requires responsible travel or visit. As a result, the rock formations and the natural resources of the cave are slowly being degraded. Bengao-ngao Cave, on the other hand, is also being utilized for educational purposes according to the 93% respondents of Barangay Ambongdolan, 87% of the respondents also said that the cave is being utilized as a habitat for plant and animal life and 67% said that it is used for recreational purposes such as picnics outside the cave and hiking for the adventurous people. Despite the obvious destruction of Crystal Cave 1, this is still being utilized for educational and ritual purposes. This is probably due to the proximity of the cave to Baguio City.

It was also found out that the peak months for tourist visit in both caves are during summer while these are closed during rainy season since the caves are being flooded with rain water making it inconvenient for tourists.

With regard to the use of water inside the cave, 40% respondents said that the water inside the cave is used for drinking as shown in Table 13 because the water seeping through the walls and roofs of the cave is potable. Based on the Bio-Physico-Chemical characterization of Bengao-ngao Cave, the water is generally clean. Forty-seven percent (47%) of the respondents said that water inside the cave is used for agricultural purposes by National Irrigation Association (NAIA) and according to 27% of



Table 13. Uses of water inside the cave (N=15)

Water utilization	Bengao-ngao Cave		Crystal Cave 1	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Agricultural purposes	7	47	0	0
Domestic purposes	0	0	0	0
Recreational purposes	4	27	0	0
Drinking purposes	6	40	0	0
None	0	0	15	100

the respondents; the water is also used for recreational purposes such as bathing. On the other hand, majority of the respondents of Purok Crystal Cave (87%) said that Crystal Cave 1 has very dirty water since this comes from the residential areas. The cave serves as the outlet of household and commercial wastes. Consequently, the water is being drained instead by the managers of the cave for convenience of the tourist that visits the said cave.

c.2. *Awareness on cave management practices.* For the awareness on the management practices being implemented on the two different caves (Table 14), it was found out that in Barangay Ambongdolan, majority of the respondents (87%) were very aware on the management and 13% are moderately aware on the management practices being implemented in Bengao-ngao Cave since they are all responsible in managing the cave while in Purok Crystal Cave, the degree of awareness on cave management are far below since only 7% and 40% are very aware and moderately aware, respectively. Among which are some of the Crystal Cave managers. However, 33% of the respondents that include the barangay officials and some residents were fairly aware and other respondents (20%) are not even aware at all of the management practices. Some respondents said that they do not really care about the cave since they are not part of the management and only the association knows the practices. The lack of involvement of





Table 14. Awareness of the residents to the management practices of the caves (N=15)

Awareness	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Very aware	13	87	1	7
Moderately aware	2	13	6	40
Fairly aware	0	0	5	33
Not aware	0	0	3	20
Total	15	100	15	100

most of the residents in Crystal Cave preservation/protection reflects the weak and poor management of the Crystal Cave 1 resulting to its further degradation.

Table 15 shows the level of effectivity of the source of information on the management practices of the caves. In Barangay Ambongdolan, the Barangay officials as source of information on the management practices being implemented in Bengaongao Cave were very effective because higher officials in the area were being respected and obeyed by the residents.

Table 15. Level of effectivity of the source of information (N=15)

Source of information	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Weighted mean	Description	Weighted mean	Description
Barangay officials	4	Very effective	3.33	Very effective
Barangay ads/posters	2.75	Moderately effective	-	-
Neighborhood	3	Moderately effective	2.25	Slightly effective
Local media	2.57	Moderately effective	3.0	Moderately effective
Co-members of the association	-	-	3.33	Very effective

\*Legend: no data (-)

Statistical limit	Description
3.25-4.0	Very effective (76-100% of the information is retained)
2.5-3.25	Moderately effective (51-75% of the information is retained)
1.75-2.5	Slightly effective (26-50% of the information is retained)
1.0-1.75	Not effective (0-25% of the information is retained)



Other sources such as Barangay ads/posters, neighborhood, and local media were moderately effective while in Purok Crystal Cave, Barangay officials as well as the Crystal Cave Guiding Association (CCGA) members were very effective as source of information on the management practices on Crystal Cave 1 since they are more authoritative than any other people. Neighborhood as source of information is slightly effective.

*c.3 .Implemented management practices.* In the preservation of Bengo-ngo Cave and Crystal Cave 1, there are some management practices that are being implemented by the community which is shown in Table 16. In Ambongdolan, Tublay, Benguet, there is a strict implementation of the rules and regulations namely prohibition of the removal and touching of any rock formation, writing on the cave's wall, use of "saleng" as a light source in entering the cave, and collection/gathering of plants and animals in the cave. Tour guides in the said barangay uses petromax and spotlight as a light source in touring (Appendix Plate 43). It was also found out that rules and regulations were listed at the municipal hall and on the road going to Bengo-ngo Cave for the tourist to read and follow (Appendix Plate 37-38). Because of the strict implementation of these rules and regulations, the beauty of the natural resources of the Bengo-ngo Cave was preserved. In Crystal Cave 1, however, the implementation of the rules and regulations are not very strict. Prohibitions on the removal of any rock formation, writing on cave walls, and touching rock formations were moderately strict in the implementation while the prohibition on the use of "saleng" as light source in entering the cave and the collection/gathering of plants and animals in the cave were slightly strict in the implementation. Based on the findings, some tourist guides used



flashlights while touring, however, the use of torch (“*saleng*”) is still being observed (Appendix Plate 44). There are no signage posted in the cave in relation to cave’s rules and regulations/tour guidelines. One respondent said that the tour guides are instructed to inform the tourists about these rules and regulations.

In relation to the rules and regulations in the management of Bengao-ngao Cave and Crystal Cave 1, sanctions were made by the managers of the cave to the violators, either a tourist or a resident of the area, of their rules and regulations. In Bengao-ngao Cave, there is a resolution made by the Barangay officials and the Municipal office of Tublay, provides that any individual who violated any rules and regulations of the barangay regarding Bengao-ngao Cave will be fined with 500 pesos. At present, there were no cases of violation in Bengao-ngao Cave because visitors were properly oriented by the tour guides before entering the cave. Moreover, the rules and regulations are written on the sign board which is posted on the side of the road going to Bengao-ngao Cave so that the tourists or visitors would be forewarned. On the case of Crystal Cave 1, according to the Crystal Cave Guiding Association (CCGA), tour guides can be suspended for 3 to 5 days depending on the violations made by the visitors they guided. Some violations include collection of rocks and writing on the walls. Based on the observation, the rules and regulations of Crystal Cave 1 were not properly disseminated to tourists. Consequently, the tourists are often holding the rock formations and sometimes collect them.



Table 16. Management practices implemented in the preservation/protection of the cave either local or national (N=15)

Rules and regulations	Bengao-ngao Cave		Crystal Cave 1	
	Weighted mean	Description	Weighted mean	Description
Prohibition of the removal of any rock formation	4	Very strict	3.17	Moderately strict
Prohibition of any writing on the cave's wall	3.93	Very strict	3.25	Moderately strict
Prohibition on the use of "saleng" as a light source in entering the cave	4	Very strict	2.33	Slightly strict
Prohibition on the collection/gathering of plants and animals in the cave	3.93	Very strict	2.22	Slightly strict
Prohibition of touching any rock formation	4	Very strict	2.63	Moderately strict
Statistical limit	Description			
3.25-4.0	Very strict (76-100% of the residents are complying)			
2.5-3.25	Moderately strict (51-75% of the residents are complying)			
1.75-2.5	Slightly strict (26-50% of the residents are complying)			
1.0-1.75	Not strict (0-25% of the complying)			

The reasons for adopting the cave management practices are shown in Table 17. In Barangay Ambongdolan, 100% of the respondents said that the reasons why they strictly implement the rules and regulations mentioned below are to preserve the flora and fauna found inside and outside the cave, to preserve the water quality of the cave, to preserve the rock formations of the cave, to comply with the barangay regulation, as additional income for the community, to protect ancestral domain, and to maintain natural beauty of the cave.



Table 17. Reasons for adopting cave management practices shown in Table 14 (N=15)

Reasons	Bengao-ngao Cave		Crystal Cave 1	
	Frequency	Percentage (%)	Frequency	Percentage (%)
To preserve the flora and fauna found inside and outside the cave	15	100	7	47
To preserve the water quality of the cave	15	100	2	13
To preserve the rock formations of the cave	15	100	10	67
To comply with the barangay regulation	15	100	1	7
Additional income for the local government	15	100	2	13
To protect ancestral domain	1	7	0	0
To maintain the natural beauty of the cave	1	7	0	0

Barangay Ambongdolan collects an entrance fee of 120 pesos per head for students and 125 pesos per head for general admission at Bengao-ngao Cave. The 20 or 25 pesos from the collection were given to the Municipal Hall of Tublay and the 100 pesos goes to the tour guide which serves as his income. Another reason for adopting such cave management practices was to protect Bengao-ngao Cave since this is their ancestral domain and they want to protect the natural beauty of the cave (7%).

In Purok Crystal Cave, on the other hand, 67% of the respondents said that they adopt such management practices to preserve the rock formations of the cave because rock formations are the only ones left that is being seen within the cave. Forty-seven percent (47%) of the respondents said that the management of the cave was to preserve the flora and fauna found inside the cave but as observed from the cave, there were no natural flora especially fauna unlike in Bengao-ngao Cave that their natural flora and fauna was preserved. Thirteen percent (13%) of the respondents also said that preserving the water quality was another purpose of the management practices but again,



water quality of the cave was very dirty because it comes from the household wastes surrounding the cave thus managers of the cave have to drain off water for the convenience of the tourists. Also, 13% of the respondents said that the reason for the management of the cave was for an additional income for the community. Tour guides in Crystal Cave 1 are collecting 80 pesos from the tourists (regardless of the number) as an entrance fee in Crystal Cave 1, 10 pesos of it goes to their association called Crystal Cave Guiding Association (CCGA) and the 70 pesos goes to the tour guide which serves as his or her income. Based on the interview, however, the income is not also fixed since if there are more than one tour guide present, they may divide the 70 pesos among themselves or depending on the tourist if they would pay each tour guide or not. Moreover, Purok Crystal Cave, Bakakeng Central does not have any part on the entrance fee collected in the Crystal Cave 1. The result implies that there is no proper management in Crystal Cave 1. Entrance fees are arbitrarily set and may create problems such as fighting among tourist guides. Barangay officials do not have any control on the cave. Consequently, the cave's natural resources are slowly being degraded.

*c.4. Indigenous knowledge system.* Table 18 shows the indigenous practices being observed in Barangay Ambongdolan and Purok Crystal Cave. In Bengaongao Cave, all of the listed indigenous practices have a weighted mean of 1.0, which implies that these practices were not being practiced or perhaps done once a month. Although according to one of the respondents, there was a mass held in the cave by a minority group seven years ago.





Table 18. Indigenous practices observed in the community in relation to the cave (N=15)

Indigenous practices	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Weighted mean	Description	Weighted mean	Description
Burial area	1.0	Not at all	1.0	Not at all
Wedding place	1.0	Not at all	1.0	Not at all
Ritual activities	1.0	Not at all	1.0	Not at all
Religious activities	1.0	Not at all	1.0	Not at all
Statistical limit	Description			
3.25-4.0	Always (4 times a month or more)			
2.5-3.25	Frequent (3 times a month)			
1.75-2.5	Often (2 times a month)			
1.0-1.75	Not at all (once a month or not at all)			

On the other hand, the listed indigenous practices were not also practiced at all as shown by its 1.0 weighted mean by the respondents in Crystal Cave. This was attributed to the mixed culture in the area as well as its urbanized setting wherein people in the area had already forgotten their traditional practices.

Table 19 shows the indigenous beliefs being observed in Barangay Ambongdolan and Purok Crystal Cave. In Barangay Ambongdolan, these indigenous beliefs were slightly perceived by the respondents. According to one of the eldest respondents, in the past years, someone had thrown a stone inside the cave and he became blind. It was believed that an unseen creature inside the cave was hurt so he cursed the man. From then on, visitors were prohibited to throw stones and any form of violence towards the cave. The indigenous beliefs in Purok Crystal Cave, on the other hand, had a weighted mean of 1.0 which implies that there are no indigenous beliefs practiced in the area towards the cave management.





Table 19. Indigenous beliefs observed in the community in relation to the cave (N=15)

Indigenous beliefs	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Weighted mean	Description	Weighted mean	Description
Cave as a sacred place	2.33	Slightly perceived	1.0	Not at all
Presence of “ <i>anitos</i> ” or unseen creatures	2.44	Slightly perceived	1.0	Not at all
Diseases/illnesses encountered to any destruction/disturbances in the cave	1.89	Slightly perceived	1.0	Not at all
Statistical limit	Description			
3.25-4.0	Always perceived (strongly adhere to the belief)			
2.5-3.25	Frequent (moderately adhere to the belief)			
1.75-2.5	Slightly perceived (often adhere to the belief)			
1.0-1.75	Not at all (don't believe at all)			

### Community Participation in the Cave Management

*a) Degree of participation.* Participation of the community is needed for effective management. The degree of participation of the respondents in the cave management of the two caves was listed in Table 20. In Barangay Ambongdolan, respondents were all very active. Clean-up drive within and outside the cave, and tree or flower planting along the vicinity to beautify the cave were done to attract more tourists. Cave management seminars were conducted in order to manage well the cave. One hundred percent of the tour guides in Barangay Ambongdolan underwent trainings and seminars together with the tour guides of Sagada Cave. One respondent said that this training and seminar programs they had was initiated by the US Peace Corps volunteer, Ms. Sherry Manning who also stayed in the area to help the residents in managing the said cave. These trainings and seminars are about safety of the tourists inside the cave and proper management of Bengao-ngao cave.



Table 20. Degree of participation of the respondents in the cave management (N=15)

Management activities	Ambongdolan, Tublay, Benguet		Crystal Cave, Bakakeng Central, Baguio City	
	Weighted mean	Description	Weighted mean	Description
Clean-up drive within and outside the cave	3.43	Very active	2.54	Moderately active
Tree/flower planting along the vicinity of the cave	3.3	Very active	2.83	Moderately active
Cave management seminar	3.4	Very active	2.0	Fairly active
Compliance with the rules and regulation in the cave management	3.67	Very active	3.09	Moderately active
Statistical limit	Description			
3.25-4.0	Very active (4 times a month or more)			
2.5-3.25	Moderately active (3 times a month)			
1.75-2.5	Fairly active (2 times a month)			
1.0-1.75	Not active (once a month or not at all)			

Moreover, it was found out that there are only maximum of 5 tourists that a tour guide must handle. According to the respondents, they are complying with the rules and regulations in the management of the said cave. All the residents in the said barangay are also members of the association called Tublay Environmental Guide Association (TEGA) that manages the Bengao-ngao Cave.

In Purok Crystal Cave, however, there is also an association known as the Crystal Cave Guiding Association (CCGA) which is responsible in the management of Crystal Cave 1. Unlike the TEGA, CCGA is a private organization composed of chosen residents who serve as tour guides in Crystal Cave 1. Unfortunately, it was found out that the barangay officials and even the DENR officers were not directly involved in the management of the cave. According to one of the barangay officials interviewed, they will only take an action if there would be a complaint or problem coming from the residents in the area and so does the DENR officer. The DENR can only make a move if



the barangay submitted a barangay resolution regarding the complaints or problems from the residents. Nevertheless, the CCGA members were moderately active in the clean-up drive and tree/flower planting activities within the vicinity of the cave. These two activities were only being actively done during summer and holidays wherein there are increased numbers of tourists visiting the cave. On the other hand, non-members of CCGA were not very active in the compliance with the rules and regulations of the cave management because they are not allowed by the members of CCGA to manage the cave and they are not being benefited from the entrance fees being collected. Furthermore, the tour guides in Crystal Cave 1 do not undergo any trainings and seminars on cave management. Anyone that lives near the cave can be a tour guide even children.

***b) Suggestions and recommendations of the community.*** In relation to the cave resources and the cave management practices, there were suggestions or recommendations of the respondents that were listed in Table 21. In Barangay Ambongdolan, 100% of the respondents recommended that there should be an ecotourism in the area. Further strict implementation of the cave management policies and practices, increase cave management practices to the community, management support from other agency responsible for cave management, and visitor orientation to prevent any damage in the area while 93 % of the respondents suggested that there should be an extensive information dissemination on the R.A. 9072 known as the National Caves and Cave Resources Management and Protection Area, and restoration of the cave should be done. These recommendations and suggestions were just needed to be improved since all these things were being implemented by the whole community of Ambongdolan. However, in Purok Crystal Cave, 73 % of the respondents recommended that there



should be strict implementation of cave management policies and practices since the management practices of Crystal Cave 1 are very poor. Sixty seven percent (67 %) of the respondents suggested that there should be information dissemination on the R.A. 9072 known as the National Caves and Cave Resources Management and Protection Area. According to one of the respondents, this law (R.A. 9072) should be explained and disseminated properly to the community and automatically be implemented. Fifty three percent (53 %) of the respondents recommended that there should be a restoration of the cave since the cave is now very prone to degradation. According to the 33 % of the respondents, there should be an increase in cave management awareness in the community. Twenty seven percent (27 %) of the respondents suggested that there should be extensive visitor orientation. The seven percent (7 %) of the respondents suggested that there should be a culvert to be built to divert the dirty water entering the cave especially during rainy season. Lastly, one of the DENR officers suggested that there should be a barangay resolution to the city to be forwarded in the DENR office for concerns relative to R.A. 9072 for DENR couldn't take any action toward the cave management without any resolution regarding the problems occurring in the area.



Table 21. Suggestions and recommendations in relation to the two caves (N=15)

Suggestions/recommendations	Ambongdolan, Tublay, Benguet		Crystal Cave 1, Bakakeng Central, Baguio City	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Information dissemination on the R.A. 9072 (National Caves and Cave Resources Management and Protected Areas)	14	93	10	67
Restoration of the cave	14	93	8	53
Ecotourism	15	100	4	27
Strict implementation of cave management policies and practices	15	100	11	73
Increase cave management awareness to the community	15	100	5	33
Management support from other agency responsible for cave management	15	100	3	20
Visitor orientation to prevent any damage in the area	15	100	4	27
Construction of culvert	-	-	1	7
Formulation of barangay resolution relative to cave management	-	-	1	7

\*Legend: no data (-)



## SUMMARY, CONCLUSION, AND RECOMMENDATIONS

### Summary

The study is entitled “The Bio-Physico-Chemical Characteristics and Management of Bengao-ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City”. Specifically, the study aimed to 1) determine and compare the two caves based on their physical parameters, chemical parameters, and biological parameters; and 2) document and compare the management practices employed by the surrounding communities on the two caves. The study was conducted from December 2008 to January 2009.

Bengao-ngao Cave had a 50 mg/L Total Suspended Solids (TSS); higher percent relative humidity which is 90% as a result of constant moisture seeping through the ceilings, walls and floors of the cave than Crystal Cave 1 having a lower value of 84.33% due to the absence of water inside the cave. The temperatures of the two caves range from 17°C - 24°C for Bengao-ngao Cave and 15°C - 17°C for Crystal Cave 1. These temperatures were attributed to the location of the caves wherein their temperature is close to the temperature of the area where they are located. The substratum of Bengao-ngao Cave is rocky and sandy, which attributes to the colder water surface temperature, which ranges from 15°C - 23°C , and warmer under water temperature, which ranges from 23°C – 23.5°C while Crystal Cave 1, has a rocky and muddy substratum.

Bengao-ngao Cave has 7 floral species having diversity index of 0.43 while Crystal Cave 1 has only 2 floral species having species diversity index of 0.23 thus, Bengao-ngao Cave is more diverse than Crystal Cave. Bengao-ngao Cave is also highly



visited by aerial and motile animals such as bats, birds, cave spider, cave cricket and frog unlike in Crystal Cave 1 which have only cave spider, flies and mosquitoes.

The management practices being implemented in the two caves reflected on the past and present situation of the two caves. The strict implementation of the rules and regulations in Bengao-ngao Cave resulted that the past and present situation of the cave was maintained and preserved. In Crystal Cave 1, however, there is a big difference between the past and present situation of the cave since their rules and regulations were not actually being disseminated to the community and the tourist. At present, Crystal Cave 1 is degraded and the water quality is very poor, thus, benefits are very limited. The residents still earn income and tourists still appreciate the cave especially first timers. Bengao-ngao Cave's water, on the other hand, is clean as reflected by its bio-physico-chemical characteristics, hence, it is being utilized for recreational and domestic purposes. Indigenous knowledge system in Ambongdolan, Tublay, Benguet is still observed while in Purok Crystal, Bakakeng Central, Baguio City, they are no longer observed due to the presence of mixed cultures and to its highly urbanized setting.

## **Conclusion**

Based on the results the following conclusions are drawn:

1. a. For the physical characteristics, Bengao-ngao Cave has a lesser amount of Total suspended solids (TSS); a high % relative humidity; a high air, surface and under water temperatures; and a rocky and sandy substratum. Crystal Cave 1, on the other hand, has no water found during the conduct of the study since the managers drained this for the accessibility of the tourists.





- b. For chemical parameters, the water in Bengao-ngao Cave is generally clean and able to support living organisms. The water in Crystal Cave, on the other hand, need to be drained by the managers because of its polluted status.
  - c. For the biological characteristics, the Bengao-ngao Cave is a more diverse ecosystem than Crystal Cave 1.
2. In terms of management practices being implemented, residents of Ambongdolan, Tublay, Benguet has a direct control and management on Bengao-ngao Cave. In Crystal Cave 1, on the other hand, has a poor cave management practices. Furthermore, some of the belief of the residents in Ambongdolan, Tublay, Benguet are still observed and thus also serves as a basis for the managing of the cave while in Crystal Cave 1, belief system is no longer observe by the people in the community.

### **Recommendation**

- A. For the management of Bengao-ngao Cave, the following are recommended.
  1. Continuous monitoring of the cave to enhance and maintain its natural beauty and to preserve its biodiversity.
  2. Extensive information education and communication campaign on the R.A. 9072 for more information in relation to management of cave.
  3. The remaining indigenous knowledge system in the community towards the cave management should be preserved for the future generation continuing the management of the cave.



4. Financial support from the municipal government for further management of the said cave (i.e. road development; and necessary materials for touring such as light source and ropes).

B. For the management of Crystal Cave 1, the following are recommended.

1. The use of “*saleng*” by the tour guides should be prohibited instead, spot light, flashlights or petromax should be utilized.
2. Local Government units (LGU) should be involved in the management of the cave.
3. The DENR should actively participate in the restoration of the cave especially that all caves are considered to be protected areas thus, it is still under their jurisdiction to protect and preserved.
4. There should be information dissemination to the community regarding the protection and the tour guides should undergo trainings and seminars on how to tour visitors the right way.
5. The community should come up with a policy or rules and regulations to be implemented inside and outside the cave for its protection and preservation.
6. Local community should not look only into the benefits or income that they receive but should take into consideration the condition of the cave. Cave should be seen as a natural resource which should be protected and maintained.
7. The managers of the cave could adopt the management strategies of Barangay Ambongdolan, Tublay, Benguet or in Sagada, Mountain Province.
8. Furthermore, temporary closure of the cave is highly recommended for its complete natural rehabilitation/restoration and diversion canal should be



constructed to divert the liquid wastes, which come from the surrounding residential areas, entering the cave.



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APPENDICES



Benguet State University  
College of Arts and Sciences  
DEPARTMENT OF BIOLOGY  
La Trinidad, Benguet



December 28, 2008

**HON. AMADOR SEPAL**  
Barangay Captain  
Ambongdulan, Tublay, Benguet

Sir:

Greetings!

This is to inform you that we, the undersigned fourth year BS in Environmental Science students are conducting our thesis study entitled, "The Bio-Physico-Chemical Characteristics and Management Practices of Bengao-Ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City during this Christmas break until February 2009. This would entail entry in your area of jurisdiction.

In this juncture, we would like to solicit authorization from your good office to allow us conduct our study in the said area. Moreover, we would like to ask permission to interview local residents, perform water analysis and gain access to pertinent documents and records relevant to our study. Rest assured that all information gathered would go a long way in the realization of the objectives of the study and we are willing to provide you a copy of the results.

Thank you and we look forward for your positive response.

Truly yours,

*Junaly*  
Bayeng, Junalyn M.

*Rodriguez*  
Cadingan, Raquel L.

*Almiller*  
Candia, Narhy L.

*Lucio*  
Lucio, Loriesol W.

*Tonged*  
Tonged, Dina M.

Recomending approval:

*Guron*  
**MARICEL A. GURON**  
Adviser

Approved by: *98-12-08*  
*Luizaldo M. Gonzalez*  
Hon. Luizaldo M. Gonzalez

Tel. No.: (6374) 422-2127 loc. 54  
Fax No.: (6374) 422-2281

e-mail: biology\_bsu@yahoo.com  
website: www.bsu.edu.ph







Benguet State University  
College of Arts and Sciences  
**DEPARTMENT OF BIOLOGY**  
La Trinidad, Benguet



January 15, 2009

**HON. ALICIA P. DIZON**  
Barangay Captain  
Bakakeng Central, Baguio City

Madam:

Greetings!

This is to inform you that we, the undersigned fourth year BS in Environmental Science students are conducting our thesis study entitled, "The Bio-Physico-Chemical Characteristics and Management Practices of Bengao-Ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City during Christmas break until February 2009. This would entail entry in your area of jurisdiction.

In this juncture, we would like to solicit authorization from your good office to allow our study in the said area. Moreover, we would like to ask to permission to interview local residents, perform water analysis and gain access to pertinent documents and records relevant to our study. Rest assured that all information gathered would go a long way in the realization of the objectives of the study and we are willing to provide you a copy of the results.

Thank you and we look forward for your positive response.

*Kag. And. A. Amiro*  
Kag. And. A. Amiro 23-01-09

Truly yours,

*Bayang*  
Bayang, Junalyn M.

*Racquel L. Cadangan*  
Cadangan, Racquel L.

*Narhy L. Cudla*  
Cudla, Narhy L.

*Lucio, Loresol W.*  
Lucio, Loresol W.

*Tonged, Dina M.*  
Tonged, Dina M.

Recomending approval:

*Maricel A. Guron*  
MARICEL A. GURON  
Adviser

3374) 422-2127 loc. 54  
3374) 422-2281

email: biology\_bsu@yahoo.com  
website: www.bsu.edu.ph



Benguet State University  
 College of Arts and Sciences  
 Department of Biology  
 La Trinidad, Benguet

January 14, 2009

ENGR. DANTE S. CHICHICCO  
 College Dean  
 College of Forestry

RECEIVED : CARREDO C. ESCOBAR  
 01/16/08

Sir:

Greetings!

This is to inform you that we, the undersigned fourth year BS in Environmental Science students are conducting our thesis study entitled, "The Bio-Physico-Chemical Characteristics and Management Practices of Bengac-ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City".

In this juncture, we would like to ask permission from your good office to allow us to light meter to use in identifying the entrance zone, twilight zone and dark zone of these caves.

Thank you very much and we look forward for your positive response.

Truly yours,

*Bayeng*  
**Bayeng, Junalyn M.**

*Cadingan*  
**Cadingan, Macquel L.**

*Quacila*  
**Quacila, Narhy L.**

*Lucio*  
**Lucio, Ederesol W.**

*Longed*  
**Longed, Dina M.**

Recommending approval:

*Guron*  
**MARICEL A. GURON**  
 Adviser





Benguet State University  
College of Arts and Sciences  
**DEPARTMENT OF BIOLOGY**  
La Trinidad, Benguet



January 21, 2009

**DR. BEN D. LADILAD**  
Regional Director  
DOST-CAR  
Km. 6, La Trinidad, Benguet

**SIR:**

This is to inform you that we, the undersigned fourth year BS in Environmental Science major in Resource Management students are currently conducting our undergraduate thesis entitled "The Bio-Physico-Chemical Characteristics and Management Practices of Bengao-Ngao Cave, Ambongdolan, Tublay, Benguet and Crystal Cave 1, Bakakeng Central, Baguio City".

In this regard, we would like to request for a discount on the payment of the water quality test (i.e. hardness) made by your office on our water samples. Your approval to our request would be of great help to us since we have very limited financial support from our parents.

Thank you very much and we look forward for your positive response.

Respectfully yours,

*Junalyn M. Bayeng*  
Junalyn M. Bayeng

*Racquel L. Cadingan*  
Racquel L. Cadingan

*Narby L. Cuadla*  
Narby L. Cuadla

*Loriesol W. Lucio*  
Loriesol W. Lucio

*Dina M. Tonged*  
Dina M. Tonged

Recommending approval:

*Maricel A. Guron*  
**MARICEL A. GURON**  
Adviser





Republic of the Philippines

Regional Office No. Cordillera Administrative Region  
Regional Standards and Testing Laboratory



DOH Accredited (#132)  
Water Testing Laboratory

### REPORT OF ANALYSIS

Agency TSR No. : 2009-189-C  
Date Submitted : January 20, 2009  
Date Analyzed : January 20, 2009  
Date Reported : January 21, 2009  
Submitted by : Customer Name : Dina M. Tonged  
Company : Benguet State University  
Address : Km 6, La Trinidad, Benguet  
Page : Page 1 of 2

SAMPLE CODE	SAMPLE DESCRIPTION	Total Hardness (as CaCO <sub>3</sub> ), mg/L
189-C-1	Tap water (500 mL) in pet bottle, covered with red cap, without seal and with written label in blue ink: Entrance-Hardness	121

### METHODOLOGY

Total Hardness. EDTA titrimetric method using Eriochrome Black T indicator (Standard Methods for the Examination of Water & Wastewater, 21<sup>st</sup> edition, 2005, Loc. No. 2-37, Method 2340C).

### REMARKS

The results given in this report are those obtained at the time of test and refer only to the particular sample submitted. This report shall not be reproduced except in full, without the written approval of the laboratory.  
\* Bureau of Food and Drugs (A.O No. 18-A s.1993), \* Philippine National Standards for Drinking Water (PNSDW, 2007)

Analyzed by:

*Eufresnie Ann D. Simbajon*  
EUFRESNIE ANN D. SIMBAJON  
Chemist License No. 7587

Confirmed by:

*Zenaida Juan Baucas*  
ZENAIDA JUAN BAUCAS  
Quality Manager

Approved for Release:

*Ben D. Ladilad*  
BEN D. LADILAD, Ph.D.  
Regional Director

Note: Not valid without DOST-CAR seal

Address: Km 6, La Trinidad, Benguet 2601  
Tel. No. ((63)(074)422-0979  
Fax No. (63)(074)422-2214

e-mail address  
URL: <http://car.dost.gov.ph>





Republic of the Philippines

Regional Office No. Cordillera Administrative Region  
Regional Standards and Testing Laboratory



DOH Accredited (#132)  
Water Testing Laboratory

### REPORT OF ANALYSIS

Agency TSR No. : 2009-189-C  
Date Submitted : January 20, 2009  
Date Analyzed : January 20, 2009  
Date Reported : January 21, 2009  
Submitted by : Customer Name : Dina M. Tonged  
Company : Benguet State University  
Address : Km 6, La Trinidad, Benguet  
Page : Page 2 of 2

SAMPLE CODE	SAMPLE DESCRIPTION	Total Hardness (as CaCO <sub>3</sub> ), mg/L
189-C-2	Tap water (500 mL) in pet bottle, covered with green cap, without seal and with written label in blue ink: Dark Zone for Hardness	187

### METHODOLOGY

**Total Hardness.** EDTA titrimetric method using Eriochrome Black T indicator (Standard Methods for the Examination of Water & Wastewater, 21<sup>st</sup> edition, 2005, Loc. No. 2-37, Method 2340C).

### REMARKS

The results given in this report are those obtained at the time of test and refer only to the particular sample submitted. This report shall not be reproduced except in full, without the written approval of the laboratory.

\* Bureau of Food and Drugs (A.O No. 18-A s.1993), \* Philippine National Standards for Drinking Water (PNSDW, 2007)

Analyzed by:

**EUFRESNIE ANN D. SIMBAJON**  
Chemist License No. 7587

Confirmed by:

**ZENAIDA JUAN BAUCAS**  
Quality Manager

Approved for Release:

**BEN D. LADILAD, Ph.D.**  
Regional Director

Note: Not valid without DOST-CAR seal

Address: Km.6, La Trinidad, Benguet 2601  
Tel. No. ((63)(074)422-0979  
Fax No. (63)(074)422-2214

e-mail address  
URL: <http://car.dost.gov.ph>





ES FORM 2



Benguet State University  
College of Arts and Sciences  
DEPARTMENT OF BIOLOGY  
La Trinidad, Benguet



### NOMINATION OF THESIS COMMITTEE

We, the undersigned, nominate the following as member of our Thesis Committee:

<u>Erlinda C. Bestre</u>	Representing	_____
Chairman		
<u>Marissa R. Parao</u>	Representing	_____
Member		
<u>Leonardo L. Samonte</u>	Representing	_____
Member		
<u>Bayeng, Junalyn M.</u>	Signature	_____ Date <u>12/01/08</u>
<u>Cadingan, Racquel L.</u>	Signature	_____ Date <u>12/04/08</u>
<u>Cuadia, Narhy L.</u>	Signature	_____ Date <u>12/04/08</u>
<u>Lucio, Loriesol W.</u>	Signature	_____ Date <u>12/04/08</u>
<u>Tonged, Dina M.</u>	Signature	_____ Date <u>12/04/08</u>

Degree Program: **Bachelor of Science in Environmental Science**  
Major: **Resource Management**

### ACCEPTANCE OF THESIS COMMITTEE MEMBERSHIP

We hereby indicate our willingness to serve as members of the Thesis Committee for the aforementioned BSES students.

<u>Erlinda C. Bestre</u>	Signature	_____	Date	<u>12/5/08</u>
Chairman				
<u>Marissa R. Parao</u>	Signature	_____	Date	<u>12/5/08</u>
Member				
<u>Leonardo L. Samonte</u>	Signature	_____	Date	<u>12/5/08</u>
Member				

Recommending Approval:

Maricel A. Guron  
Name and Signature of Thesis Adviser  
Date: 12/15/08

Approved:

Maricel A. Guron  
MARICEL A. GURON  
Department Chairman



ES FORM 3



Benguet State University  
College of Arts and Sciences  
**DEPARTMENT OF BIOLOGY**  
La Trinidad, Benguet



### APPLICATION FOR THESIS PROPOSAL DEFENSE

Name of Students: Junalyn M. Bayeng  
Racquel L. Cadingan  
Nahy L. Cudta  
Loreel W. Lucio  
Dina M. Tonged

Degree Program: **Bachelor of Science in Environmental Science**  
Major: **Resource Management**

Title of Thesis Proposal: The Bio-physico-chemical Characteristics and Management Practices of Bengao-ngao cave, Ambongdolan, Tublay, Benguet and Crystal cave 1, Bakakeng, Central, Baguio City

Schedule of Thesis Proposal Defense:

Date: December 19, 2008  
Time: 3:00 PM  
Place: GAS 300A

### THESIS COMMITTEE

Name of Member	Signature
<u>Erlinda C. Bestre</u> Chairman	
<u>Marissa R. Parao</u> Member	
<u>Leonardo L. Sazonic</u> Member	

Recommending Approval:

Maricel A. Guron  
Name and Signature of Thesis Adviser  
Date: \_\_\_\_\_

Approved:

**MARICEL A. GURON**  
Department Chairman





ES FORM 4

Benguet State University  
College of Arts and Sciences  
DEPARTMENT OF BIOLOGY  
La Trinidad, Benguet

## REPORT ON THESIS PROPOSAL DEFENSE

Date of Filing of Application

Name of Students: Junalyn M. Baveng  
Racquel L. Cadingan  
Narhy L. Cuadla  
Loriesol W. Lucio  
Dina M. Jonged

Degree Program: Bachelor of Science in Environmental Science  
Major: Resource Management

Title of Thesis Proposal: The Bio-phico-chemical Characteristics and Management Practices  
Of Bengao-ngao Cave, Ambongdolan, Tublay, Benguet and  
Crystal Cave, Bakakeng Central, Baguio City

Schedule of Thesis Proposal Defense:  
Date: 19 December 2008  
Time: 3:00 PM  
Place: CAS 309

### THESIS COMMITTEE

	Remarks*
<u><i>Erlinda C. Bestre</i></u> Erlinda C. Bestre, Ph.D. Chairman (Signature & Date)	<u><i>Passed</i></u>
<u><i>Marissa R. Parao</i></u> Marissa R. Parao, Ph.D. Member (Signature & Date)	<u><i>passed</i></u>
<u><i>Leonardo L. Samonte</i></u> Leonardo L. Samonte, Ph.D. Member (Signature & Date)	<u><i>Passed</i></u>

\* PASSED/RE-DEFENSE/FAILED

Noted:

*Maricel A. Guron*  
MARICEL A. GURON, M.B.S.  
Thesis Advisor (Signature)

Date

Approved:

*Maricel A. Guron*  
MARICEL A. GURON  
Department Chairman

Date



ES FORM 5

Benguet State University  
College of Arts and Sciences  
DEPARTMENT OF BIOLOGY  
La Trinidad, Benguet



## APPLICATION FOR THESIS FINAL DEFENSE

13 March 2009

Date of Filing of Application

Name of Students: BAYENG, Junalyn M.  
CADINGAN, Racquel L.  
CUADLA, Narhy, L.  
LUCIO, Loriesol W.  
TONGED, Dina M.

Degree Program: Bachelor of Science in Environmental Science  
Major: Resource Management

Title of Thesis: The Bio-physico-chemical Characteristics and Management *Practises*  
of Bengao-ngao Cave, Ambongdolan, Tublay Benguet and  
Crystal Cave 1, Bakakeng, Central, Baguio City

Schedule of Thesis Final Defense:

Date: March 19, 2009  
Time: 3:00 pm  
Place: CAS 309

### THESIS COMMITTEE

<u>Erlinda C. Bestre, Ph.D.</u> Chairman	<u><i>Erlinda C. Bestre</i></u> <u>3-16-09</u> Signature & Date
<u>Marissa R. Parao, Ph.D.</u> Member	<u><i>Marissa R. Parao</i></u> <u>3/17/09</u> Signature & Date
<u>Leonardo L. Samonte, Ph.D.</u> Member	<u><i>Leonardo L. Samonte</i></u> <u>3-17-09</u> Signature & Date

Recommending Approval:

*Maricel A. Guron*  
Maricel A. Guron, M.B.S. 3/17/09  
Thesis Adviser (Signature) Date

Approved:

*Maricel A. Guron*  
MARICEL A. GURON, M.B.S. 3/17/09  
Department Chairmen (Signature) Date



ES FORM 6

Benguet State University  
College of Arts and Sciences  
DEPARTMENT OF BIOLOGY  
La Trinidad, Benguet

## REPORT ON THESIS FINAL DEFENSE

Date of Filing of Application

Name of Students: Bayeng, Junalyn M.  
Cadigan, Racquel L.  
Cuadria, Narhy L.  
Lucio, Loriesol W.  
Tonged, Dina M.

Degree Program: Bachelor of Science in Environmental Science  
Major: Resource Management

Title of Thesis Proposal: The Bio-physico-chemical Characteristics and Management Practices  
Of Bengao-ngao Cave, Ambongdolan, Tublay, Benguet and  
Crystal Cave 1, Bakakeng, Central, Baguio City

Schedule of Thesis Final Defense:

Date: March 19, 2009  
Time: 3:00 P.M.  
Place: CAS 309

### THESIS COMMITTEE

	Remarks*	
<u>Erlinda C. Bestre, Ph.D.</u> Chairman	<u>Passed</u>	<u>[Signature]</u> (Signature & Date)
<u>Marissa R. Parao, Ph.D.</u> Member	<u>Passed</u>	<u>[Signature]</u> (Signature & Date)
<u>Leonardo L. Samonte, Ph.D.</u> Member	<u>Passed</u>	<u>[Signature]</u> (Signature & Date)

\* PASSED/RE-DEFENSE/FAILED

Noted:

[Signature]  
**MARICEL A. GURON, M.B.S.**  
Thesis Adviser (Signature)      3/19/09  
Date

Approved:

[Signature]  
**MARICEL A. GURON, M.B.S.**  
Department Chairman (Signature)      3/19/09  
Date



Benguet State University  
College of Arts and Sciences  
DEPARTMENT OF BIOLOGY  
La Trinidad, Benguet

### APPROVAL SHEET FOR THESIS BINDING

Name of Students: BAYENG, Junalyn M.  
CADINGAN, Racquel L.  
CUADLA, Narhy L.  
LUCIO, Loriesol W.  
TONGED, Dina M.

Degree Program: **Bachelor of Science in Environmental Science**  
Major: **Resource Management**

Title of Thesis: The Bio-physico-chemical Characteristics and Management  
Practices of Bengao-ngao, Cave, Ambongdolan, Tublay,  
Benguet and Crystal Cave 1, Bakakeng Central, Baguio City

Schedule of Thesis Final Defense:  
Date: 19 March 2009  
Time: 3:30 PM  
Place: CAS 309

#### THESIS COMMITTEE

	Remarks*	
<u>Erlinda C. Bestre, Ph.D.</u> Chairman	<u>Approved</u>	<u>4/3/09</u> (Signature & Date)
<u>Marissa R. Parao, Ph.D.</u> Member	<u>approved</u>	<u>4/2/09</u> (Signature & Date)
<u>Leonardo L. Samonte, Ph.D.</u> Member	<u>Approved</u>	<u>04/01/09</u> (Signature & Date)

\*Approved/Disapproved

Noted:

MARICEL A. GURON, M.B.S.

Thesis Adviser (Signature)

04/01/09

Date

Approved:

MARICEL A. GURON, M.B.S.

Department Chairman (Signature)

04/01/09

Date



# Appendix B (Tables)



**Appendix Table 1.** Physical parameters of Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

PARAMETERS	SAMPLING STATION												GRAND TOTAL	GRAND AVE.
	Zone 1				Zone 2				Zone 3					
	S1	S2	S3	Ave.	S1	S2	S3	Ave.	S1	S2	S3	Ave.		
Total Suspended Solids (mg/L)	100				-				0				0	<b>50</b>
Percent Relative Humidity (%)	92				85				93				270	<b>90</b>
Temperature (°C)														
• Air	18	17	17.5	17.5	22	21	21.5	21.5	24	23	24	23.67	62.67	<b>20.89</b>
• Surface water	15	15	15	15	-	-	-	-	23	23	23	23	38	<b>19</b>
• Under water	-	-	-	-	-	-	-	-	23	23.5	23	23.17	23.17	<b>23.17</b>
Substratum	Rocky				Sandy				Rocky					

**Appendix Table 2.** Physical parameters of Crystal Cave 1, Bakakeng Central, Baguio City.

PARAMETERS	SAMPLING STATION												GRAND TOTAL	GRAND AVE.
	Zone 1				Zone 2				Zone 3					
	S1	S2	S3	Ave.	S1	S2	S3	Ave.	S1	S2	S3	Ave.		
Total Suspended Solids (mg/L)	-				-				-				-	-
Percent Relative Humidity (%)	77				92				84				253	<b>84.33</b>
Temperature (°C)														
• Air	17	15.5	15	15.83	16	16	16	16	16.5	16.5	16.5	16.5	48.33	<b>16.11</b>
• Surface	-	-	-	-	-	-	-	-	-	-	-	-	-	-





water	-	-	-	-	-	-	-	-	-	-	-	-	-	-
• Under water	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substratum	Rocky and Muddy				Rocky and Muddy				Rocky and Muddy					

**Appendix Table 3.** Chemical parameters of Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

PARAMETERS	SAMPLING STATION												GRAND TOTAL	GRAND AVE.
	Zone 1				Zone 2				Zone 3					
	S1	S2	S3	Ave.	S1	S2	S3	Ave.	S1	S2	S3	Ave.		
Dissolved Oxygen (mg/L)	5.5				-				5				10.5	<b>5.25</b>
Hardness (mg/L)	121				-				187				308	<b>154</b>
pH	8	8.1	7.8	7.97	-	-	-	-	8	8	8	8	15.97	<b>7.99</b>

**Appendix Table 4.** Chemical parameters of Crystal Cave 1, Bakakeng Central, Baguio City.

PARAMETERS	SAMPLING STATION												GRAND TOTAL	GRAND AVE.
	Zone 1				Zone 2				Zone 3					
	S1	S2	S3	Ave.	S1	S2	S3	Ave.	S1	S2	S3	Ave.		
Dissolved Oxygen (mg/L)	-				-				-				-	-
Hardness (mg/L)	-				-				-				-	-
pH	-	-	-	-	-	-	-	-	-	-	-	-	-	-

\*Remarks – no water in the cave during the time of the study.....





**Appendix Table 5.** Floral diversity in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

NAME OF THE SPECIES	NUMBER OF THE SPECIES												GRAND TOTAL
	Zone 1				Zone 2				Zone 3				
	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	
Moss ( <i>Sphagnum sp.</i> )	100	100	95	295	0	0	0	0	0	0	0	0	<b>295</b>
Maidenhair fern ( <i>Adiantum capillus-veneris</i> Linn.)	76	0	0	76	0	0	0	0	0	0	0	0	<b>76</b>
Fern ( <i>Cheilanthes dilimanensis</i> )	0	15	0	15	0	0	0	0	0	0	0	0	<b>15</b>
“Pehaw”/Wild Gabi ( <i>Taenitis luzonica</i> )	4	21	30	55	0	0	0	0	0	0	0	0	<b>55</b>
Sipa-sipa ( <i>Ageratina riparia</i> )	0	1	0	1	0	0	0	0	0	0	0	0	<b>1</b>
“Copdas”/Gipah Tea ( <i>Sarrandra glabra</i> )	0	1	0	1	0	0	0	0	0	0	0	0	<b>1</b>
“Apas”	0	1	0	1	0	0	0	0	0	0	0	0	<b>1</b>
<b>TOTAL</b>													<b>444</b>



**Appendix Table 6.** Floral diversity in Crystal Cave 1, Bakakeng Central, Baguio City.

NAME OF THE SPECIES	NUMBER OF THE SPECIES												GRAND TOTAL
	Zone 1				Zone 2				Zone 3				
	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	
Gabi ( <i>Colocasia esculenta</i> Linn.)	0	0	0	0	0	0	0	0	2	0	0	2	2
Angels Trumpet ( <i>Datura inoxia</i> )	0	0	0	0	1	0	0	1	3	3	0	6	7
<b>TOTAL</b>													<b>9</b>

**Appendix Table 7.** Faunal Diversity in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

NAME OF THE SPECIES	NUMBER OF THE SPECIES												GRAND TOTAL
	Zone 1				Zone 2				Zone 3				
	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	
Black Ant	15	5	12	32	0	0	0	0	0	0	0	0	32
Moth	2	0	0	2	0	0	0	0	0	0	0	0	2
Cave Spider	0	1	0	1	0	0	0	0	0	0	0	0	1
Cave Beetle	0	0	1	1	0	0	0	0	0	0	0	0	1
<b>TOTAL</b>													<b>37</b>



**Appendix Table 8.** List of motile and aerial faunal species outside the sampling plots of each zone of the two caves.

BENGAO-NGAO CAVE	CRYSTAL CAVE 1
Bats	Cave Spider
“Pipingew	Cluster Flies
Cave Spider	Mosquitoes
Cave Cricket	
Cave Frog	

**Appendix Table 9.** Floral diversity in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet showing the different quantitative parameters.

SPECIES	Ni	Di (m <sup>2</sup> )	RDi (%)	Fi (%)	RFi (%)	Importance Value (%)
Moss ( <i>Sphagnum sp.</i> )	295	32.7778	66.4415	33.3333	27.2727	<b>46.8571</b>
Maidenhair fern ( <i>Adiantum capillus-veneris</i> Linn.)	76	8.4444	17.1170	11.1111	9.0909	<b>13.1040</b>
Fern ( <i>Cheilanthes dilimanensis</i> )	15	1.6667	3.3784	11.1111	9.0909	<b>6.2347</b>
“Pehaw”/Wild Gabi ( <i>Taenitis luzonica</i> )	55	6.1111	12.3874	33.3333	27.2727	<b>19.8301</b>
Sipa-sipa ( <i>Ageratina riparia</i> )	1	0.1111	0.2252	11.1111	9.0909	<b>4.6581</b>
“Copdas”/Gipah Tea ( <i>Sarrandra glabra</i> )	1	0.1111	0.2252	11.1111	9.0909	<b>4.6581</b>
“Ap-pas”	1	0.1111	0.2252	11.1111	9.0909	<b>4.6581</b>
<b>TOTAL</b>	<b>444</b>	<b>49.3333</b>	<b>99.9999</b>	<b>122.2221</b>	<b>99.9999</b>	<b>100.0002</b>



**Appendix Table 10.** Floral species of Crystal Cave 1, Bakakeng Central, Baguio City showing the different quantitative parameters.

SPECIES	Ni	Di (m <sup>2</sup> )	RDi (%)	Fi (%)	RFi (%)	IMPORTANCE VALUE (%)
Gabi ( <i>Colocasia esculenta</i> Linn.)	2	0.2222	22.22	11.1111	25	<b>23.61</b>
Angels Trumpet ( <i>Datura innoxia</i> )	7	0.7778	77.78	33.3333	75	<b>76.39</b>
<b>TOTAL</b>	<b>9</b>	<b>1.0000</b>	<b>100</b>	<b>44.4444</b>	<b>100</b>	<b>100</b>

**Appendix Table 11.** Faunal diversity in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet showing the different quantitative parameters.

SPECIES	Ni	Di (m <sup>2</sup> )	RDi (%)	Fi (%)	RFi (%)	IMPORTANCE VALUE (%)
Black Ant	32	3.5556	88.8900	33.3333	50	<b>69.445</b>
Moth	1	0.2222	5.5555	11.1111	16.6667	<b>11.1109</b>
Cave Spider	1	0.1111	2.7775	11.1111	16.6667	<b>9.7221</b>
Cave Beetle	1	0.1111	2.7775	11.1111	16.6667	<b>9.7221</b>
<b>TOTAL</b>	<b>37</b>	<b>4.0000</b>	<b>100</b>	<b>66.6666</b>	<b>100.0001</b>	<b>100.0001</b>

**Appendix Table 12.** Summary of computed floral diversity index in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

SPECIES	Ni	Pi	log Pi	Pi log Pi
Moss ( <i>Sphagnum sp.</i> )	295	0.6664	-0.1776	-0.1180
Maidenhair fern ( <i>Adiantum capillus-veneris</i> Linn.)	76	0.1712	-0.7665	-0.1312
Fern ( <i>Cheilanthes dilimanensis</i> )	15	0.0338	-1.4711	-0.0497
“Pehaw”/Wild Gabi ( <i>Taenitis luzonica</i> )	55	0.1239	-0.9069	-0.1124
Sipa-sipa ( <i>Ageratina riparia</i> )	1	0.0023	-2.6383	-0.0061
“Copdas”/Gipah	1	0.0023	-2.6383	-0.0061



Tea ( <i>Sarrandra glabra</i> )				
“Ap-pas”	1	0.0023	-2.6383	-0.0061
<b>TOTAL</b>	<b>444</b>			<b>-0.4296</b>

$$S = 7$$

$$N = 444$$

$$\begin{aligned} H' &= -\sum (ni/N) \log (ni/N) \\ &= -(-0.4296) \\ &= \mathbf{0.4296} \end{aligned}$$

$$\begin{aligned} H'_{\max} &= \log S \\ &= \log 7 \\ &= \mathbf{0.8451} \end{aligned}$$

$$\begin{aligned} \text{Evenness (J)} &= \frac{H'}{H'_{\max}} \\ &= \frac{0.4296}{0.8451} \\ &= \mathbf{0.5083} \end{aligned}$$

**Appendix Table 13.** Summary of computed floral diversity index in Crystal Cave 1, Bakakeng Central, Baguio City.

SPECIES	Ni	Pi	log Pi	Pi log Pi
Gabi ( <i>Colocasia esculenta</i> Linn.)	2	0.2222	-0.6533	-0.1452
Angels Trumpet ( <i>Datura inoxia</i> )	7	0.7778	-0.1091	-0.0849
<b>TOTAL</b>	<b>9</b>			<b>-0.2301</b>

$$S = 2$$

$$N = 9$$

$$\begin{aligned} H' &= -\sum (ni/N) \log (ni/N) \\ &= -(-0.2301) \\ &= \mathbf{0.2301} \end{aligned}$$

$$\begin{aligned} H'_{\max} &= \log S \\ &= \log 2 \\ &= \mathbf{0.3010} \end{aligned}$$

$$\begin{aligned} \text{Evenness (J)} &= \frac{H'}{H'_{\max}} \\ &= \frac{0.2301}{0.3010} = \mathbf{0.7645} \end{aligned}$$



**Appendix Table 14.** Summary of computed faunal diversity index in Bengao-ngao Cave, Ambongdolan, Tublay, Benguet.

SPECIES	Ni	Pi	log Pi	Pi log Pi
Black Ant	32	0.8641	-0.0630	-0.0545
Moth	2	0.0541	-1.2668	-0.0685
Cave Spider	2	0.0541	-1.2668	-0.0685
Cave Beetle	1	0.0270	-1.5686	-0.0424
<b>TOTAL</b>	<b>37</b>	<b>0.9993</b>	<b>-4.1652</b>	<b>-0.2339</b>

$$S = 4$$

$$N = 37$$

$$\begin{aligned} H' &= -\sum (ni/N) \log (ni/N) \\ &= - (-0.2339) \\ &= \mathbf{0.2339} \end{aligned}$$

$$\begin{aligned} H'_{\max} &= \log S \\ &= \log 4 \\ &= \mathbf{0.6021} \end{aligned}$$

$$\begin{aligned} \text{Evenness (J)} &= \frac{H'}{H'_{\max}} \\ &= \frac{0.2339}{0.6021} \\ &= \mathbf{0.3885} \end{aligned}$$



# Appendix C (Plates)







**Appendix Plate 1.** Forest area where Bengao-ngao Cave is located.



**Appendix Plate 2.** Top view where the Bengao-ngao cave is located.





**Appendix Plate 3.** A (water from commercial and residential area flowing into the cave) and B (upper portion of Crystal Cave 1).



**Appendix Plate 4.** Rocky substratum of Bengao-ngao Cave





**Appendix Plate 5.** Rocky (A) and muddy (B) substratum of Crystal Cave 1



**Appendix Plate 6.** Wild gabi or “*pehaw*” found in the entrance zone of Bengao-ngao Cave.



**Appendix Plate 7.** Maiden fern together with the mosses found in the entrance zone of Bengao-ngao Cave.



**Appendix Plate 8.** *Copdas* found in the entrance zone of Bengao-ngao Cave







**Appendix Plate 9.** *Ap-pas* found in the entrance zone of Bengao-ngao Cave.



**Appendix Plate 10.** Angels trumpet found in the inner zones of Crystal Cave 1.





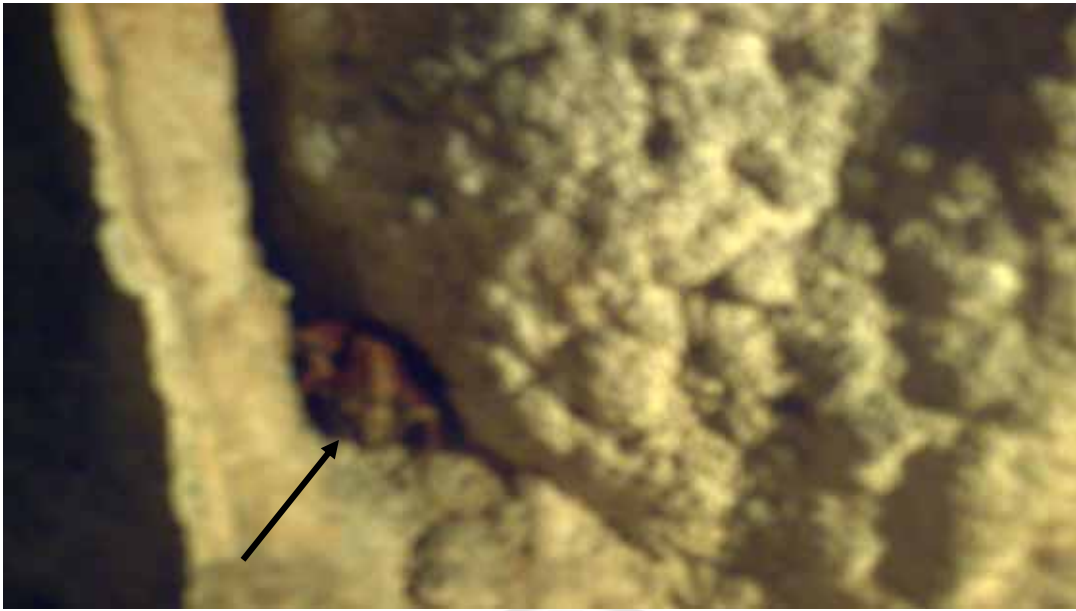
**Appendix Plate 11.** Gabi found in the inner zones of Crystal Cave 1.



**Appendix Plate 12.** Cave cricket found in the entrance zone of Bengao-ngao Cave.







**Appendix Plate 13.** Cave frog found in the entrance zone of Bengao-ngao Cave.



**Appendix Plate 14.** Cave spider found in Bengao-ngao Cave (A) and Crystal Cave 1 (B).



Appendix Plate 15 – 21 shows the stalagmites rock formation in Bengao-ngao Cave.



Plate 15. Wishing stone



Plate 16. Dog-like formation



Plate 17. Melted candle-like formation



Plate 18. Goat pellets-like formation





Plate 19



Plate 20



Plate 21. Sunny-side-up egg-like formation



**Appendix Plate 22 – 24** shows the stalactites rock formation in Bengao-ngao Cave.



Plate 22. Shell-like formation



Plate 23



Plate 24. Mushroom-like formation





**Appendix Plate 25– 29** shows the flow stones rock formation in Bengao-ngao Cave.



Plate 25. Cauliflower-like formation



Plate 26. Crocodile teeth-like formation



Plate 27. Column formation





Plate 28. Rice terraces-like and column formation



Plate 29. Sitting monkey-like formation



Appendix Plate 30-31 shows the stalactites rock formation in Crystal Cave 1 covered with black soot from “*saleng*” .



Plate 30



Plate 31

Appendix Plate 32- 35 shows the flow stones rock formation in Crystal Cave 1.



Plate 32. Crocodile teeth-like formation



Plate 33







Plate 34. Ampalaya-like formation



Plate 35. Column formation



**A**



**B**

Appendix Plate 36. Cellophanes (A) and styrofoam (B) hanging inside the cave.





Appendix Plate 37-38. Signage showing the prohibited activities inside Bengao-ngao Cave.



Plate 37



Plate 38





**Appendix Plate 39.** Establishment of quadrat in Bengao-ngao cave (A) and Crystal Cave 1 (B)



**Appendix Plate 40.** On-site chemical analysis (Bengao-ngao Cave)





**Appendix Plate 41.** Determination of temperature in Bengao-ngao Cave (A) and Crystal Cave 1 (B).



**Appendix Plate 42.** Determination of humidity in Bengao-ngao Cave (A) and Crystal Cave 1 (B).





**Appendix Plate 43.** An interview with elders in Ambongdolan, Tublay



**Appendix Plate 44.** Tour guides in Crystal Cave 1 using “saleng”.



**Appendix Plate 45.** Tour guides in Bengao-ngao Cave using petromax.



# Appendix D

## (Survey Questionnaires)



### Semi-Structured Survey Questionnaire

Name: \_\_\_\_\_  
 Age: \_\_\_\_\_ Educational Attainment: \_\_\_\_\_  
 No. of years staying in the area: \_\_\_\_\_

#### A. CAVE ASSESSMENT BY THE RESPONDENTS.

1. How would you assess the past and the present situation of the cave? (Please identify and check according to the criteria).

**Numerical value: Qualitative Description: Criteria:**

4	Very Good	76-100 % of the cave is preserved/not altered/ not destroyed
3	Good	51-75 % of the cave is preserved/not altered// not destroyed
2	Fair	26-50 % of the cave is preserved/not altered/ not destroyed
1	Poor	0-25 % of the cave is preserved/not altered/ not destroyed

Cave Characteristics	Past				Present			
	4	3	2	1	4	3	2	1
<b>A. Within the cave</b>								
1. Rock formation:								
a. Stalactites								
b .Stalagmites								
c .Flow stones								
2. Water quality								
3. Plants								
4. Animals								
<b>B. Outside the cave</b>								
5. Plants								
6. Animals								

2. What are the uses of the cave in your community? (Please check).

\_\_\_\_\_ Ritual purposes  
 \_\_\_\_\_ Habitat for plant and animal life  
 \_\_\_\_\_ Recreational purposes  
 \_\_\_\_\_ Educational purposes (i.e. research/study, etc.)  
 \_\_\_\_\_ Ecotourism purposes





\_\_\_\_\_ Others (please specify)

\_\_\_\_\_

\_\_\_\_\_

3. What are the uses of water found inside the cave? (Please check).

- \_\_\_\_\_ Agricultural purposes
- \_\_\_\_\_ Domestic purposes
- \_\_\_\_\_ Recreational purposes
- \_\_\_\_\_ Drinking purposes
- \_\_\_\_\_ Others (please specify)
- \_\_\_\_\_
- \_\_\_\_\_

## B. MANAGEMENT AND IMPLEMENTATION

1. As a resident of Ambongdolan, Tublay, Benguet / Crystal cave, Bakakeng Central, Baguio city, are you aware of any management practices (protection and preservation) of Bengao-ngao cave/Crystal cave? (Please check).

- \_\_\_\_\_ Very Aware (well informed)
- \_\_\_\_\_ Moderately Aware (informed but not in detailed)
- \_\_\_\_\_ Fairly Aware (slightly informed/poor knowledge)
- \_\_\_\_\_ Not Aware (no information at all)

How did you get the information? (Please check your source of information, and rate the level of effectivity).

Numerical value	Qualitative Description	Criteria
4	Very effective	76-100 % of the information is retained
3	Moderately effective	51-75 % of the information is retained
2	Slightly effective	26-50 % of the information is retained
1	Not implemented	0-25 % of the information is retained

Source of Information (Please check, if any)	Level of Effectivity			
	4	3	2	1
1. Barangay officials				
2. Barangay ads/posters				
3. Neighborhood (i.e. friends, family)				
4. Local media (radio, TV)				
Others (please specify) _____				



2. What are the management practices being implemented in the preservation/ protection of the cave either local or national? (Please check, if any, and rate the degree of implementation).

Numerical value	Qualitative Description	Criteria
4	Very strict	76-100 % of the residents and barangay officials are complying
3	Moderately strict	51-75 % of the residents and barangay officials are complying
2	Slightly strict	25-50 % of the residents and barangay officials are complying
1	Not strict	0-25 % of the residents and barangay officials are complying

Rules and Regulations (Please check, if any)		Degree of Implementation			
		4	3	2	1
<input type="checkbox"/>	Prohibition of the removal of any rock formation				
<input type="checkbox"/>	Prohibition of any writing on the cave's wall				
<input type="checkbox"/>	Prohibition on the use of "saleng" as a light source in entering the cave				
<input type="checkbox"/>	Prohibition on the collection/gathering of plants and animals in the cave				
<input type="checkbox"/>	Prohibition of touching the rock formation				
<input type="checkbox"/>	Others (please specify) _____ _____ _____				

3. What are the reasons for adopting such management practices? (Please check)

- To preserve the flora and fauna found inside and outside the cave  
 To preserve the water quality of the cave  
 To preserve the rock formations of the cave  
 To comply with the Barangay regulation  
 Additional income for the local and national revenue (ecotourism)  
 Others (please specify)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



### C. ISSUES AND CONCERNS ABOUT THE CAVE

1. What are the problems encountered within the cave environment? (Please check, if any, and rate the level of severity).

Numerical value	Qualitative Description	Criteria
4	Very severe	76-100 % of the problems were encountered
3	Moderately severe	51-75 % of the problems were encountered
2	Slightly severe	26-50 % of the problems were encountered
1	Not severe	0-25 % of the problems were encountered

Problems Encountered (Please check, if any)		Level of Severity			
		4	3	2	1
<input type="checkbox"/>	Improper liquid waste management				
<input type="checkbox"/>	Improper solid waste management				
<input type="checkbox"/>	Collection of crystalline				
<input type="checkbox"/>	Collection of plant specimens				
<input type="checkbox"/>	Collection of animal species				
<input type="checkbox"/>	Use of light source like for example "saleng", gas lamp etc.				
<input type="checkbox"/>	Vandalizing (i.e. writing on the cave's wall, touching of rock formations.				
<input type="checkbox"/>	Others, please specify				
	_____				
	_____				

2. What do you think would happen with the cave if the community would not have participated in the management of the cave? (Please check).

- \_\_\_\_\_ Destruction of rock formations  
 \_\_\_\_\_ Alteration of plant and animal life found inside and outside the cave.  
 \_\_\_\_\_ Pollution of the cave water  
 \_\_\_\_\_ Others (please specify )

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



## D. COMMUNITY PARTICIPATION IN THE CAVE MANAGEMENT

1. How would you rate the degree of your participation? (Please check, if any, and rate the level of participation).

Numerical value	Qualitative Description	Criteria
4	Very active	4 times a month or more
3	Moderately active	3 times a month
2	Fairly active	2 times a month
1	Not active	once a month or not at all

Management Activities (Please check, if any)	Level of Participation			
	4	3	2	1
Clean-up drive within and outside the cave				
Tree planting along the vicinity of the cave				
Cave management seminar				
Compliance with the rules and regulation in the cave management				
Others, please specify _____				

2. What can you suggest or recommend in relation to the cave resources? (Please check, if any, and rank with 1 as the highest). For key-informant only.

- \_\_\_\_\_ Information dissemination on the RA 9072 known as the National Caves and Cave Resources Management and Protection Act
- \_\_\_\_\_ Restoration of the cave.
- \_\_\_\_\_ Ecotourism
- \_\_\_\_\_ Strict implementation of cave management policies and practices
- \_\_\_\_\_ Increase cave management awareness to the community
- \_\_\_\_\_ Management support from the DENR and other agency responsible for cave management
- \_\_\_\_\_ Visitor orientation to prevent any damage in the area
- \_\_\_\_\_ Others (please specify )

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# Appendix E (Related Articles)



REPUBLIC ACT No. 9072  
 AN ACT TO MANAGE AND PROTECT CAVES AND CAVE RESOURCES AND  
 FOR OTHER PURPOSES

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**Congress of the Philippines**  
**Eleventh Congress**  
**Third Regular Session**

**REPUBLIC ACT NO. 90729135**      **April 8, 2001**

**AN ACT TO MANAGE AND PROTECT CAVES AND CAVE RESOURCES AND  
 FOR OTHER PURPOSES**

*Be it enacted by the Senate and House of Representatives of the Philippines in Congress  
 assembled:*

**Section 1. Title** - This Act shall be known as the "National Caves and Cave Resources Management and Protection Act."

**Section 2. Declaration of Policy** - It is hereby declared the policy of the State to conserve, protect and manage caves and cave resources as part of the country's natural wealth. Towards this end, the State shall strengthen cooperation and exchange of information between governmental authorities and people who utilize caves and cave resources for scientific, educational, recreational, tourism and other purposes.

**Section 3. Definition of Terms** - For purposes of this Act, the following terms shall be defined as follows:

(a) "Cave" means 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. The term also includes cave resources therein, but not any vug, mine tunnel, aqueduct or other manmade excavation.

(b) "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, speleogems and speleothems.

(c) "Secretary" means the Secretary of the Department of Environment and Natural Resources (DENR)



(d) "Speleogem" means relief features on the walls, ceilings and floor of any cave or lava tube which are part of the surrounding bedrock, including but not limited to anastomoses, scallops, meander niches, petromorphs and rock pendants in solution caves and similar features unique to volcanic caves.

(e) "Speleothem" means any natural mineral formation or deposit occurring in a cave or lava tube, including but not limited to any stalactite, stalagmite, helictite, cave flower, flowstone, concretion, drapery, rimstone or formation of clay or mud.

(f) "Significant Cave" refers to a cave which contains materials or possesses features that have archaeological, cultural, ecological, historical or scientific value as determined by the DENR in coordination with the scientific community and the academe.

**Section 4. Implementing Agency** - The DENR shall be the lead agency tasked to implement the provisions of this Act in coordination with the Department of Tourism (DOT), the National Museum, the National Historical Institute and concerned local government units (LGUs) for specific caves, except that in the Province of Palawan, the Palawan Council for Sustainable Development shall be the lead implementing agency pursuant to Republic Act No. 7611 or the Strategic Environmental Plan for Palawan Act.

**Section 5. Powers and Functions of the Department of Environment and Natural Resources (DENR)** - In the implementation of this Act, the DENR shall exercise the following powers and functions:

(a) Formulate, develop and implement a national program for the management, protection and conservation of caves and cave resources:

(b) Disseminate information and conduct educational campaign on the need to conserve, protect and manage our caves and cave resources:

(c) Issue permits for the collection and removal of guano and other cave resources which shall be determined in coordination with the DOT, National Museum, concerned LGUs, the scientific community and the academe, with regard to specific caves taking into consideration bio-diversity as well as the aesthetic and archaeological value of the cave: Provided, that the permittee shall be required to post a bond to ensure compliance with the provisions of any permit: Provided further that any permit issued under this Section shall be revoked by the Secretary when the permittee violates any provision of this Act or fails to comply with any other condition upon which the permit was issued: Provided furthermore, That the Secretary cannot issue permits for the removal of stalactites and stalagmites, and when it is established that the removal of the resources will adversely affect the value of a significant cave: Provided Finally, That caves located within a protected area shall be subjected to the provisions of Republic Act No. 7586 or the National Integrated Protected Area System Act of 1992;





- (d) Call on any local government unit, bureau, agency, state university or college and other instrumentalities of the government for assistance as the need arises in the discharge of its functions;
- (e) Enter into a memorandum of agreement with any local government unit (LGU) for the preservation, development and management of cave or caves located in their respective territorial jurisdiction;
- (f) Tap the cooperation of people's and nongovernmental organizations as active partners in the conservations and protection of our caves and cave resources; and
- (g) Exercise other powers and perform other functions as may be necessary to implement the provisions of this Act.

**Section 6. *Information Concerning the Nature and Location of Significant Caves*** - Information concerning the nature and specific location of a potentially significant cave shall not be made available to the public within one (1) year after its discovery by the DENR, during which time the DENR in coordination with the DOT, the National Museum, the National Historical Institute, concerned LGUs the scientific community and the academe shall assess its archaeological, cultural, ecological, historical and scientific value, unless a written request is made and the Secretary determines that disclosure of such information will further the purpose of this Act and will not create a substantial risk of harm, theft or destruction on such cave.

The written request shall contain, among others, the following:

- (a) a description of the geographic site for which the information is sought:
- (b) an explanation of the purpose for which the information is sought:
- (c) an assurance or undertaking satisfactory to the Secretary that adequate measures are to be taken to protect the confidentiality of such information and to ensure the protection of the cave from destruction by vandalism and unauthorized use.

**Section 7. *Prohibited Acts*** - The following shall be considered Prohibited Acts.

- (a) Knowingly destroying, disturbing, defacing, marring, altering, removing, or harming the speleogem or speleothem of any cave or altering the free movement of any animal or plant life into or out of any cave:
- (b) Gathering, collecting, possessing, consuming, selling, bartering or exchanging or offering for sale without authority any, cave resource; and
- (c) Counselling, procuring, soliciting or employing any other person to violate any provisions of this Section.



**Section 8. Penalties** - Any person found guilty of any of the offenses enumerated under Section 7 hereof shall be punished by imprisonment from two (2) years to six (6) years or a fine ranging from Twenty thousand pesos (P20,000) to five hundred thousand pesos (P500,000.00) or both at the discretion of the Court: Provided That the person furnishing the capital to accomplish the acts punishable herein shall be punished by imprisonment from six (6) yrs and one (1) day to eight (8) years or by a fine ranging from Five hundred thousand pesos (P500,000.00) to One million pesos (P1,000,000.00) or both at the Discretion of the Court. Provided further that if the area requires rehabilitation or restoration as determined by the Court, the offender shall also be required to restore the same, whenever practicable or compensate for the damage: Provided finally that if the offender is a government employee, he or she shall likewise be removed from office.

**Section 9. Administrative Confiscation and Conveyance** - The Secretary shall order the confiscation, in favor of the Government of the cave resources gathered, collected, removed, possessed or sold including the conveyance and equipment used in violation of Section 7 hereof.

**Section 10. Fees** - Any money collected by the DENR as permit fees for collection and removal of cave resources, as a result of the forfeiture of a bond or other security by a permittee who does not comply with the requirements of such permit issued under this Act or by way of fines for violations of this Act shall be remitted to the National Treasury.

**Section 11. Implementing Rules and Regulations** - The DENR shall, within six (6) months from the effectivity of this Act, issue rules and regulations necessary to implement the provisions hereof.

**Section 12. Appropriations** - The amount necessary to carry out the provisions of this Act shall be included in the General Appropriations Act of the year following its enactment into law and thereafter.

**Section 13. Separability Clause** - If any provisions of this Act is subsequently declared unconstitutional, the remaining provisions shall remain in full force and effect.

**Section 14. Repealing Clause** - Presidential Decree No. 1726 - A is hereby modified. Treasure hunting in caves shall be governed by the provisions of this Act.

Except Presidential Decree No. 412 and Republic Act No. 4846, all other laws, decrees, orders and regulations or parts thereof which are inconsistent with any of the provisions of this Act are hereby repealed or amended accordingly.

**Section 15. Effectivity** - This Act shall take effect fifteen (15) days following its publication in two (2) national newspapers of general circulation.

Approved: April 8, 2001



Approved:

**AQUILINO Q. PIMENTEL JR.**

President of the Senate

**FELICIANO BELMONTE JR.**

Speaker of the House of Representatives

This Act which is a consolidation of House Bill No. 7275 and Senate Bill No. 1956 was finally passed by the House of Representatives and the Senate on February 8, 2001 and February 5, 2001, respectively.

**LUTGARDO B. BARBO**

Secretary of the Senate

**ROBERTO P. NAZARENO**

Secretary General

House of Representatives

Approved:

**GLORIA MACAPAGAL-ARROYO**

President of the Philippines

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