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SUBJECT: GUIDELINES IN SAFEGUARDING CAVES UTILIZED FOR ECOTOURISM

Pursuant to Republic Act No. 9072 (National Caves and Cave Resources Management and Protection Act), DAO 2013-19 (Guidelines on Ecotourism Management and Planning in Protected Areas), DMC No. 2007-04 (Procedure in Cave Classification), BMB Technical Bulletin No. 2014-03 (Prescribed Tools for Impact Monitoring of Ecotourism Activities) and other existing rules and regulations and support policies, this Technical Bulletin is issued for the guidance of all concerned in the development and implementation of ecotourism in caves.

Section 1. Rationale. Caves are considered unique, natural, and fragile ecosystems with important scientific, economic, educational, cultural, historical, and aesthetic values. However, many of our caves are endangered due to some inappropriate and uncontrolled use.

All entry into a cave, whether deliberate or not, can create disturbance that can lead to alterations of the cave environment. Any actions of visitors inside and outside of the cave will affect its condition as well as its resources and may deny the future generations enjoyment of this natural resource.

Section 2. Objectives. This Technical Bulletin aims to provide guidelines in terrestrial cave ecotourism. It will provide specific strategies in the management and conservation of caves to be utilized for ecotourism. Specifically, it aims to achieve the following objectives:

1. To identify and provide a range of environmental and social safety nets to address and minimize the impacts of ecotourism activities to sustain ecosystem services provided by caves and its resources;
2. To maintain the integrity of cave and its resources to foster economic benefits to host communities and ensure the satisfaction of visitors; and

3. To encourage multi-stakeholder participation in the development and monitoring of ecotourism activities within and around the caves.

Section 3. Scope and Coverage. This Technical Bulletin shall cover the development and implementation of ecotourism activities inside and immediate vicinity of caves and cave systems, both in public and private lands, as well as protected areas, that have been classified as Class II and III caves pursuant to DENR Memorandum Circular No. 2007-04 on the Procedure in Cave Classification.

Section 4. General considerations. Cave is one of the most interesting natural resources which are home to specialized mineral formations with unique and diverse flora and fauna. However, despite their diversity and significance, most of the caves in the country are being exploited due to the lack of specific statutory protection, increased demand for recreational sites, treasure hunting, mining, pollution, illegal collection of cave resources, and rapid urbanization.

The development of caves for ecotourism purposes demands careful planning, including considerations for sustainability to guarantee optimal protection, conservation, sustainable use of caves and its resources while securing economic growth. Thus, it is needed to formulate guidelines that can ensure equilibrium between conservation of these fragile environments and sustainable economic development.

Caves shall be assessed and classified to determine the biological, geological, hydrological, paleontological, archaeological, historical and cultural value in accordance with the DENR Memorandum Circular 2007-04, *Procedure in Cave Classification*. Only Class III caves and specific sections of Class II caves may be opened for ecotourism. Caves should be subjected to appropriate zoning and management planning based on the assessment results.

Ecotourism and infrastructure development in and around caves shall be in accordance with the DENR Administrative Order No. 2013-19, *Guidelines in Ecotourism Planning and Management in Protected Areas* and DENR Administrative Order No. 2009-09, *Standard Design and Specification of Signs, Buildings, Facilities and Other Infrastructure that may be Installed and/ or Constructed within Protected Areas*.

Cave Guides shall be accredited in accordance with the *Rules and Regulations to Govern the Accreditation of Ecoguides, Ecotours, Ecolodges, and Ecotour Facilities* issued by the Department of Tourism in 2008 to ensure that the guides have the necessary caving and first aid skills. Only DOT – Accredited Cave Guides shall be permitted to bring guests in and out the caves.

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Detailed discussions on the management and conservation of caves utilized for ecotourism are provided in the attached Guidelines.

Section 5. Specific considerations. This Technical Bulletin includes safeguards pertaining to the protection of biological, archaeological, geological, hydrological, paleontological values.

- a. **Biological.** This covers general guidelines on cave biota protection, such as zoning parts of the cave with notable and/or sensitive taxa including a) vertebrates such as bats, swiftlets, herpetofauna, aquatic vertebrates, b) invertebrates such as insects and related arthropods, molluscs, aquatic invertebrates, c) microorganisms such as bacteria, fungi, and d) biota outside caves (fauna and flora in a cave's vicinity).
- b. **Archeological.** Caves have high cultural and scientific significance and since the appearance of modern man on the planet, caves have been very essential means of human's survival. Due to its economic potentials, there are some initiatives for the development of heritage or archaeological tourism. As such, studies have been done on several archaeological caves in order to measure its potentials for ecotourism. Careful planning should be done for effective and efficient management of caves to preserve cultural heritage.
- c. **Geological.** Caves offer diverse resources such as in economic, educational, scientific and recreational but they are highly vulnerable to some environmental conditions. Therefore, factors in the implementation of protective policies should include maintenance of natural hydrological system and avoidance of heavy developments in karst areas.
- d. **Hydrological.** Karst areas are characterized by hydrological features not present elsewhere such as springs, waterfalls, subterranean rivers, cave pools and dry streams that lose water underground (Kaufmann, 2007). These features define the hydrological processes within subsurface conduits such as caves which should remain undisturbed to maintain the life of the cave. Thus, careful management of flow and condition of fluids should be considered to attain successful ecotourism management of caves.
- e. **Paleontological.** Cave systems in the Philippines are dominantly karstic landscapes brought upon by dissolution of limestones. Sometimes, in cases of exceptional preservation, we may see traces of remains of these organisms, which are called **fossils.**

Fossils are extremely valuable specimens for geologists and paleontologists because they are the only means of knowing what life forms existed in the geologic past thus they must remain intact within the cave premises to serve as learning specimen.

Section 6. Visitor Management. Ecotourism activity inside caves will definitely have negative impacts. The carrying capacity study shall be conducted to determine the level of visitation that a cave may sustain. Careful monitoring of visitor activity and their impacts is an important component of any ecotourism plan. This Technical Bulletin provides guidelines before, during, and after entry for cave guides, visitors, and managers such as: strict implementation of visitor registration system, wearing proper caving attire and providing informative tours to visitors

Section 7. Sustainable Infrastructure. Caves for ecotourism demands careful planning for compatibility of infrastructure and facilities for the protection and conservation of caves and cave resources. Basic infrastructure and facilities are constructed to meet the needs of visitors but should have minimum impact on the environment. Some considerations in the development of structures and facilities in caves are also provided in Annex A.

Section 8. Public Awareness. Well-designed communication strategies shall be developed to promote environmental education and public awareness to improve conservation efforts in caves.

Section 9. Monitoring. The DENR Regional/Field Offices shall conduct annual monitoring. However, for caves with influx of visitors, monitoring should be done at least twice a year, preferably before and after the peak season of visitor arrival.

Section 10. Reporting. Cave focal person shall submit an annual monitoring report that will include the analyzed data and recommended actions to the concerned Regional Director and copy furnish BMB Director.

This Technical Bulletin is hereby issued for the guidance of all concerned.



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GUIDELINES IN SAFEGUARDING CAVES UTILIZED FOR ECOTOURISM

I. Rationale

Caves are considered unique, natural, and fragile ecosystem with important scientific, economic, educational, cultural, historical, and aesthetic values. However, many of our caves are endangered due to some inappropriate and uncontrolled use.

All entry into a cave, whether deliberate or not, can create disturbance that can lead to alterations of the cave environment. Any actions of visitors inside and outside of the cave will affect its condition as well as its resources and may deny the future generations enjoyment of this natural resource.

II. Objectives

This aims to provide guidelines in terrestrial cave ecotourism. It will provide specific strategies in the management and conservation of caves to be utilized for ecotourism. Specifically, it aims to achieve the following objectives:

1. To identify and provide a range of environmental and social safety nets to address and minimize the impacts of ecotourism activities to sustain ecosystem services provided by caves and its resources;
2. To maintain the integrity of cave and its resources to foster economic benefits to host communities and ensure the satisfaction of visitors; and
3. To encourage multi-stakeholder participation in the development and monitoring of ecotourism activities within and around the caves.

III. Definition of Terms

As used in this guidelines, the following are defined as follows:

- a. Bad air – refers to the condition of air in caves characterized by low levels of oxygen, high levels of carbon dioxide and other hazardous gases such as methane. Low levels of oxygen and high levels of carbon dioxide in caves or certain cave passages pose dangers to the human body. Bad air is indicated by hyperventilation, increased heart rate, dizziness, dry acidic taste in the mouth, increased pulse rate, labored breathing, and headache.
- b. Balanced circuit - an electrical or electronic circuitry where the signal or power is transferred symmetrical in two wires.
- c. Biota - the animal and plant life of a particular region, habitat, or geological period.

- d. Caves – refer to 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 any vug, mine tunnel, aqueduct or other man-made excavation.
- e. Class I Caves – refer to caves that are closed to public, with delicate and fragile geological formations, threatened species, archeological and paleontological values, and extremely hazardous conditions. Allowable activities are limited to mapping, photography, and educational and scientific purpose.
- f. Class II Caves – refer to some areas or portions of the caves are closed, seasonally or permanently, due to hazardous conditions and/ or contain sensitive geological, archaeological, cultural, historical and biological values or high quality ecosystem. It is open to guided educational tours/ visits.
- g. Class III Caves – refer to caves which are generally safe even to inexperienced visitors and open to guided educational tours/ visits.
- h. Ecotourism – is a form of sustainable tourism within a natural and/or cultural heritage area where community participation, protection, management of natural resources, cultural and indigenous knowledge and practices, environmental education, ethics and economic benefits are fostered to the host communities and satisfaction of visitors.
- i. Ecotourism Management Plan – is a plan which identifies realistic strategies to achieve long-term goals for a business or business segment for a specific cave.
- j. Ecotourism Product – refers to a combination of ecotourism resources, facilities, activities and services resulting in enhanced commitment to protect the natural and cultural heritage areas.
- k. Edible bird's nests – are bird nests created by swiflets (genus *Collocalia*) using solidified saliva, that is made chiefly of the dried glutinous secretion of salivary glands of the birds which are harvested for human consumption used in making soup.
- l. Guano – large accumulations of bat and bird dung, often mineralized, including rock fragments, animal skeletal material and products of reactions between excretions and rock.
- m. Invertebrates - any animal lacking a backbone, including all species not classified as vertebrates such as insects, crustaceans, arachnids, and mollusks.

- n. Keystone species – any plant or animal that plays a unique and crucial role in the way an ecosystem functions.
- o. Lamp – any form of light source installed in caves
- p. Lamp Flora - any kind of photosynthetic organisms such as algae, plants and microorganisms growing in the vicinity of lamps such as cyanobacteria, algae, lichens, mosses and ferns (Dobàt, 1963; Cigna, 2011).
- q. Troglobite - a cave organism that is unable to live outside the cave environment.
- r. Troglophile - a cave organism that frequently spends most of its life inside a cave but is not confined to the cave environment.
- s. Troglaxene - a cave organism that spends only part of its life cycle inside the cave but frequents the surface for food
- t. Stygobites - those highly specialized animals living entirely in the groundwater environment, and absent in surface waters
- u. Stygophiles – animals or organisms found in both surface and underground waters without adaptation to subterranean life
- v. Stygoxenes - organisms that appear rarely, and almost randomly, in underground waters but are essentially surface dwellers
- w. Vertebrates - Any of a large group of animals having a backbone, including fish, amphibians, reptiles, birds, and mammals. Vertebrates are bilaterally symmetrical and have an internal skeleton of bone or cartilage, a nervous system along the back that is divided into brain and spinal cord, and not more than two pairs of limbs.

IV. General considerations

Caves shall be assessed and classified to determine the biological, geological, hydrological, paleontological, archaeological, historical and cultural value in accordance with the DENR Memorandum Circular 2007-04: *Procedure in Cave Classification*. Only Class III caves and specific sections of Class II caves may be opened for ecotourism. Caves should be subjected to appropriate zoning and management planning based on the assessment results.

Ecotourism and infrastructure development in and around caves shall be in accordance with the DENR Administrative Order No. 2013-19: *Guidelines in Ecotourism Planning and Management in Protected Areas*, and DENR Administrative Order No. 2009-09: *Standard Design and Specification of Signs, Buildings, Facilities and Other Infrastructure that may be Installed and/ or Constructed within Protected Areas*.

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V. Specific considerations

Caves harbor biological, archeological, paleontological, geological, hydrological, and cultural values that should be taken into consideration when managing caves.

A. Biological

Ecotourism in caves require planning for both inside and outside of the cave to guarantee optimal protection, conservation, sustainable use of caves and its resources while securing economic growth. Zoning shall be incorporated in cave maps of survey grade 3C or above. The designated stations during the assessment of the cave shall be used in the management planning based on the results of the cave assessment. However, this may be updated depending on the results of the monitoring and/or new discoveries of passageways.

Uncontrolled entry of visitors may lead to stress, disturbance, displacement, and worse, mishandling can increase mortality to existing populations. This affects not only the health of the cave, but the economic gains of the local community due to the loss of wildlife as an attraction and biodiversity as a whole. Areas with existing populations of organisms should either be closed to visitors to avoid such cases or only a very limited and carefully selected visitors should be allowed to enter such areas.

A.1. Vertebrates

- a. Bats are keystone species in caves. If they were removed from an ecosystem, the overall health of the ecosystem will deteriorate, posing a threat to the survival of other species of animals and plants. Bats in general provide majority of volume of guano - the primary energy source in caves. Proper identification of bat populations to species level including their conservation status is of high priority. Cave managers should also take note of the population size of bats inhabiting caves. There are chambers in caves where high concentrations of bats can be found as well as high volumes of guano. These areas should be closed to visitors to avoid disturbing the bats and also due to the likeliness of the presence of bad air. The time of emergence of bats and return for roosting should also be considered.
- b. Swiftlets are not only a source of guano for the energy cycling process inside the cave, some species are also economically important due to their edible birds nests. Similar to bat populations, swiftlets shall be properly identified to determine their conservation status for proper zoning and management. Nest collection of non-threatened species of swiftlet may be utilized for

regulated nest collection and closed to visitors to minimize disturbance. The time of emergence of swiftlets and return for roosting should also be considered. Further, collection of wildlife and their derivatives or by-products requires necessary permits from DENR.

- c. Some reptiles and amphibians are also known to inhabit caves. Some snakes are known to use caves from short to significant amounts of time, preying on bats as they fly out of the cave. Lizards are sometimes observed in entrances as well (Culver and White, 2005). These should also be taken into consideration in cave management as they are also significant in cave community structures.

A.2. Invertebrates

- a. Insects and related arthropods – Cave crickets, spiders, beetles, cave cockroaches, cave centipedes, and other cave-dwelling arthropods are of very high significance in the conservation of cave ecosystems. Due to their localized residence compared to bats which may migrate between multiple caves, changes in arthropod populations (species composition, richness, abundance) are exceptional subjects for monitoring the health of a cave ecosystem.
- b. Mollusks (clams, snails and their relatives) are another group of invertebrates that should be taken into consideration in cave management. Cave-dwelling mollusks are important members of the cave ecosystem.

A.3. Aquatic Life and their Habitat

Streams, pools, or any other form of water found in terrestrial caves should not be disturbed, particularly those known to be inhabited by stygobites. Bodies of water in caves may also be inhabited by microorganisms significant in the cave ecosystem. Water flow patterns in caves should not be altered as these could affect stream scouring of sedimentation, especially areas inhabited by stygobites. Pools should not be drained as a source of groundwater or for the convenience of visitors. Blowing out or draining a rimstone down could strand or kill cave life (Elliott, 2006).

A.4. Organisms outside caves

Caves are extremely dependent of the outside environment for energy inputs. Degradation of the environment outside of caves will greatly affect their health, their functions, the populations of cave fauna, and the aesthetic value of formations of caves. Flora and fauna identified in the vicinity of the cave shall be taken into consideration. A buffer zone shall be designated around the cave where no infrastructure aside from necessary signage, ladders, trails, and railings for the safety of guides and visitors are to be installed.

B. Archaeological

Caves have high cultural and scientific significance and since the appearance of modern man on the planet about 200,000 years ago, caves have been very essential means of human's survival. Prehistoric humans used caves as dwelling place, source of water, place in making pottery, tools and weapons; and site for protection from heavy rain, cold during winter and heat of summer. Eventually, humans used caves to bury their dead, to perform ceremonial or ritual activities; or to express their artistic talents.

Due to its economic potentials, there are some initiatives for the development of heritage or archaeological tourism. As such, studies have been done on several archaeological caves in order to measure its potentials for ecotourism. Careful planning should be done for effective and efficient management of caves to preserve cultural heritage. As such the following must be observed to minimize the impact of ecotourism activities in caves with archaeological values:

- a. As per R.A. 10066, also known as the National Cultural Heritage Act of 2009, any form of excavations/resource extraction inside and the immediate outside vicinities of caves will require proper clearance. This requirement should be secured from the National Museum to determine if archaeological and paleontological resources shall be disturbed and/or affected;
- b. Visitors should not gather/collect archaeological and paleontological resources/materials whenever such are found inside the caves and their immediate outside vicinities; and
- c. Visitors should not write, vandalize, deface or mutilate any part of the cave (inside and outside).

C. Geological

C.1. Lithological Characteristics

Caves occur in a wide variety of rock types formed through different geological processes. Their formation and development is called *speleogenesis*. Their sizes reach miles in length divided into several chambers with interconnected passages. Most of these naturally occurring features are found in karst landscapes. Limestone and dolomite usually comprise karst areas characterized by topography reliant upon underground water solution and diversion of surface waters to underground conduits. Other caves are formed through volcanic activity and wave action in pseudokarst environments.

These natural wonders offer diverse opportunities such as in economic, educational, scientific and recreational (ecotourism) aspects, but they are highly vulnerable to some environmental conditions. Therefore, considerations in the implementation of protective policies should include maintenance of the natural hydrological system and avoidance of heavy development in karst areas.

- a. Solution Caves

The most abundant, largest and commonly-occurring caves are composed of limestone. They can also form in dolomite, marble, salt, gypsum and other soluble rocks. Dissolving these soluble rocks through the action of acid water that seeps along bedding-planes, faults, joints and tension cracks define *solution cave* formations.

b. Other type of caves

Volcanic activity and wave action contribute to the formation of other types of caves. *Lava tubes* are formed as lava flows downhill where its surface cools and solidifies. Continuous flow under the crust develops into insulating conduits for transporting fresh molten lava to the flow front (US Geological Survey, n.d.). On the other hand, *sea caves or littoral caves* are formed along the coasts through wave action in zones of weakness or structurally controlled portions within sea cliffs and littoral caves (National Caves Association, 2014). Another cave type is the *talus cave* consisting of pile of boulders, usually granite or volcanic rocks, formed through tectonically or rain-induced rock movements. It typically occurs in mountainous areas near cliffs.

Some of the caves are categorically unsafe for ecotourism since our country is a tectonically active region challenged with natural hazards such as tropical cyclones, storm surge, tsunami, landslide, flooding, subsidence, volcanic eruption and others. The solution caves composed of limestone are the most vulnerable due to their high solubility. With the presence of tectonic structures, degradation of these kinds of caves is rapid. Considering also the unstable pile of boulders in talus caves, they are unsafe for ecotourism and must be evaluated carefully.

It is recommended that comprehensive assessment/exploration of caves be done to ensure that the lithological characteristics of the caves are considered, especially with regards to the safety aspects in ecotourism.

C.2. Cave Formations

Caves have prominent features or formations, also known as speleothems which are secondary mineral deposits. Stalactites and stalagmites consist some of these spectacular formations. Stalactites hang downward from the ceiling when drop after drop of water slowly trickles through cracks in the cave roof while stalagmites propagate upward from the floor caused by the water dripping from overhanging stalactites (US Geological Survey, 2014). Union of these dripstone features form columns. Other cave formations formed within the bedrock through erosional and dissolution processes are called speleogens. They have sculpted distinct shapes and relief features on cave's walls, ceilings and floors. Examples of speleogens are pillars, scallops, boneyard and boxwork. Typically, these are found in solution caves.

Acts leading to disruption and destruction of speleothems and speleogens must be prohibited such as touching, vandalism, cutting off and carving. Preservation and protection of these magnificent features should be of major importance in accordance with its development for recreation and ecotourism.

C.4. Geohazard

Sinkholes are one of the most common karst structures in the world and are found in a wide variety of geological settings (Festa et al, 2012). Sinkholes are common and a natural feature of a karst landscape.

In karst topography, subsidence poses threats associated with sinkhole or cave collapse. Sinkhole collapse is now considered as one of the most dangerous hazards in the country due to its extreme unpredictability. Collapse incidents could happen in a snap of a second or in a very slow rate of ground subsidence. The presence of sinkholes in an area indicates that additional sinkholes may develop in the future. Man-made structures in the vicinity of sinkholes are at risk for structural damage unless they have been adequately designed.

Subsidence in karst landscape is not only triggered by a strong earthquake, but may also be due to gravity, flooding, lowering of water table, ponding of subterranean river and subsidence in coral reef. Throughout their development, karst and sinkhole formation may be influenced by natural factors such as tectonics and climate (Katen, 2013).

There are several types of sinkholes which include cover-subsidence, cover collapse and solution. Karst subsidence is often associated with collapse of cover-subsidence type sinkholes. In cover collapse, the overburden is composed of a significant amount of clay. Over time, surface drainage and erosion induce production of a cavity as spalling continues. The cavity progresses upward forming an arch then eventually, the overburden collapses creating sudden sinkholes. For a solution sinkhole, a thin overburden is percolated by water therefore affecting rapidly the rock surface. Dissolution focuses on the preexisting openings, fractures, bedding planes and in the zone of water-table fluctuation where groundwater is in contact with the atmosphere.

Vigilant monitoring of areas near caves must be implemented especially where signs of subsidence such as spalling and heaving of cave roof are present. In some cases, subsiding roads indicate failing roof of caves or collapsing sinkholes. Signages should be installed informing the public of the threat of subsidence. It is recommended that careful assessment of these caves be considered for the safety of tourists and cave enthusiasts. If conditions are not favourable, these caves must be closed for ecotourism.

Aside from subsidence, another danger in small unventilated caves is the presence of toxic gases. These include carbon dioxide, carbon monoxide, sulfur dioxide, ammonia, methane and others. This should be taken into consideration

if caves will be used for ecotourism since long exposure to toxic gases can lead to certain health conditions such as hyperventilation, increased heart rate, vertigo, headache and others related cases.

Some solution caves are generally part of a drainage system where active streams naturally runs inside. Flash flooding can occur during rainstorms. Therefore, advisories on thunderstorms should be frequently monitored for the safety of tourists.

D. Hydrology

Karst areas are characterized by hydrological features not present elsewhere such as springs, waterfalls, subterranean rivers, cave pools and dry streams that lose water underground (Kaufmann, 2007). These features define the hydrological processes within subsurface conduits such as caves which should remain undisturbed to maintain the life of the cave.

When stream water collectively flows through sinkholes and enters through conduits as sinking stream, it may recur as surface streams or exit as spring or waterfalls. In the case of the formation of cave pools, sinkhole intersects the water table. Well-developed karst areas characterize directions of underground systems as inconsistent due to its ambiguity based on the geological structures and surface topography they follow.

Underground flow times are often rapid resulting in erosion and cleansing of some sediment-laden caves. Thus, careful management of flow and condition of fluids should be considered to attain successful ecotourism management of caves (Watson, et. al., 1997). Diversion and destruction of water pathways must be avoided to prevent degradation of the cave system, and enhancement of cave and sinkhole collapse.

E. Paleontological

Cave systems in the Philippines are dominantly karstic landscapes brought upon by dissolution of limestones. These limestones are formed from the accumulation of carbonate-building organisms. Sometimes, in cases of exceptional preservation, we may see traces of remains of these organisms, which are called fossils.

Not all remains of organisms become preserved as fossils. Most of them decay and are broken down by bacteria. Therefore, finding a fossil in limestone means that the remains of the organism, despite diagenesis, have been preserved. Fossils found in caves will be an exceptional find since significant dissolution processes have already taken place.

Evidence of past life forms can be explored through fossils within caves. Usually, these preserved organisms are found on carbonate caves such as limestone and dolomite. These types of rocks developed over millions of years when shallow seas dominated. Such rocks often contain fossils of organisms that lived and died in these waters. Other fossils include abundant small animal remains in cave sediments. Some of

these, particularly micromammals, are important paleoenvironmental indicators (Schubert, n.d.) Shifting in their lifespan is due to changing climatic conditions.

E.1. Invertebrates

Caverns that are geologically young in age, such as those found in Panglao in Bohol, still have fossil corals preserved since they have only been exposed for a short period of geologic time. Fossils of bivalves, gastropods, and sea urchin spines can also be seen in other localities. They have not yet undergone severe dissolution so these remains will be common in young karsts. However, older rock formations will have very little of these preserved because of longer exposure to dissolution.

Invertebrate fossils found in caves may be common especially in young karsts. However, extraction of these objects should be prohibited especially to locals and tourists. Fossils should only be taken out of caves with the permission of the Regional Cave Committee (RCC) or the Department of Environment and Natural Resources (DENR), along with geologists, paleontologists, and speleologists present.

E.2. Vertebrates

Exceptional cases of vertebrate fossils unearthed in caves include bones of man in Palawan and Cagayan (e.g., Fox, 1970; Mijares et al., 2010), rodents in Cagayan (e.g., Heaney et al., 2011), bovines in Cebu (e.g., Croft et al., 2006), ribs of a sea cow in Palawan, and a possible *Carcharodon megalodon* (extinct giant shark) tooth in Samar.

Vertebrate fossils are very rare in the Philippines and therefore needs to be preserved. These specimens should only be removed upon agreement with government agencies concerning this matter. Fossil experts along with speleologists and geologists should be part of the fossil extraction team. A representative from the government agencies concerned must be present at the time of extraction.

Fossils are extremely valuable specimens for geologists and paleontologists because they are the only means of knowing what life forms existed in the geologic past. They provide a strong evidence for the Theory of Evolution. Furthermore, assemblages of fossils found in an area may provide clues in knowing the past environment in which these organisms lived.

These fossils must remain intact within the cave premises to serve as learning specimen for lectures which may be given by tour guides. Excavation and removal of these fossils must be banned to preserve the scientific value they offer.

All fossils extracted are considered as the property of the State. These specimens should be surrendered to concerned government agencies. The agencies, however, must

be able to secure the storage of the specimens so that the quality of these fossils will not be compromised.

F. Cave resources

Economic activities in caves are associated with limestone and guano extractions. The excretion of cave dwelling animals, specifically bats, is known as guano, which can be used as an effective fertilizer and gunpowder ingredient due to its high phosphorus and nitrogen content. Existing and proposed policies are present related to the banning and regulation of guano extraction and other cave resources in the country. Disturbance of wildlife and guano-dependent animals should be avoided through discouraged extraction of these resources (Department of Environment and Natural Resources, n.d.). Section 7 of Republic Act No. 9072, also known as the "National Caves and Cave Resources Management and Protection Act" prohibits the following 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.

Another cave resource is limestone which is an important resource for industrial use. Crushed limestones are used as base road filling, aggregate in concrete and in portland cements. Powdered limestone can also reduce pollution through absorption. However, it is recommended that limestone extraction within and in the immediate vicinities of caves with archaeological, historical and eco-tourism potentials should be prohibited. Strict implementation of regulatory requirement and formulation of local policies are imperative to ensure protection and preservation of these caves against destruction as a consequence of extraction of limestone materials and other cave resources.

VI. Visitor Management

Visitor counts in ecotourism destinations should be taken into account to monitor the volume of tourists. Uncontrolled visitors may pose negative impact in ecotourism sites thus making it difficult for site managers to reconcile visitor satisfaction and conserving biodiversity. Thus, it is vital to determine the carrying capacity of cave used for tourism purposes.

The monitoring of visitor impacts are fundamental ecotourism management strategy. Careful monitoring of impacts, both positive and negative, needs to be a primary activity of the site's overall management because if threats will not be addressed, these could result to a lesser visitor experience, and congestion may occur in ecotourism destinations. The data to be collected will provide a baseline that will determine the impacts of tourism and the efficacy of the responsible agency's management strategies in the conservation of the cave ecosystem.

Cave visitors shall be accompanied by duly accredited cave guides/ecoguides to ensure their safety as well as to provide educational experience and protect the cave and its resources from damage. As a precautionary measure, the following should be observed:

A. Before entry:

A.1. Cave Guides should:

- a. strictly implement the visitor registration system and other cave rules;
- b. brief the cave visitors on the following:
 - c. Do's and don'ts inside and around the caves
 - d. Cave classification
 - e. Cave resources
 - f. Penalties
 - g. Cave management
 - h. Proper decorum
- i. ensure that cave visitors are in proper attire before entering the cave;
- j. keep the number of the cave visitors small and manageable. The ideal ratio of guide-tourist is 2:4. High influx of visitors induce disturbance to populations of cave-dwelling organisms as well as trigger compaction of the cave floor;
- k. do head count of all cave visitors;
- l. advise visitors to use the comfort room before entering caves. Human secretions and excretions pollute the caves and will incur damage to them; and
- m. provide visitors with waste bags to avoid littering inside the cave. These bags must be disposed outside the cave.

A.2. Visitors should:

- a. register at the Protected Area/Tourist Information Center. This provides cave managers crucial data and information on cave visitors and how frequent caves are visited. Registration form must include the following:
 - Name of visitor
 - Address
 - Gender/Sex
 - Nationality
 - Contact information
 - Organization/Institution
 - Purpose of visit
 - Time of Departure
 - Estimated Time of Arrival
 - Person to contact with in case of emergency
- b. sign waivers prior to cave entry;
- c. adhere to guidelines given by guides during the briefing; and
- d. Wear caving attire properly before entering the cave. Lightweight clothes, pants, sleeved tops, helmets and headlights are mandatory. *Proper footwear*

shall be worn – closed shoes/boots with good traction. *Footwear – particularly the soles, shall be cleaned/rinsed with water before entering the cave.* This minimizes the introduction of pollutants and organisms that may be harmful to sensitive organisms residing inside the cave.

A.3. Cave managers should:

- a. Ensure that the mandatory helmets and headlights are available for use/rental by cave visitors;

B. While caving:

B.1. Cave Guides should:

- a. provide informative tour to visitors. It is very important that environmental educational awareness and respect is attained by both visitors and guides throughout the tour;
- b. keep up with the pace of the slowest cave visitor/s;
- c. point out/warn guests of low ceiling cave formations or narrowing passages;
- d. ensure that the cave visitor/s do not wander alone inside the cave;
- e. always carry first aid kit while guiding; and
- f. make sure to control the visitor traffic in every cave section

B.2. Visitors should:

- a. listen to the cave guides at all times to ensure maximum value of the tour is achieved and accidents prevented;
- b. walk only on the designated pathways to avoid accidents, getting lost, touching of formations, artifacts, ecofacts and mishandling of biota;
- c. always be on the lookout for low ceiling cave formations or narrowing passages;
- d. avoid littering, smoking, or doing any other form of pollution. Such actions are not tolerated in any cave and is punishable by law;
- e. avoid holding or vandalizing the cave walls and formations;
- f. avoid harming, disturbing, damaging, extracting and hunting any cave organisms. Such actions shall subject the offender to the charges pursuant to Republic Act 9072 and its Implementing Rules and Regulations;
- g. removal of artifacts such as pots shards, stone tools and tradeware ceramics, and ecofacts (bones, fossils, shells) from caves and similar features is strictly prohibited;
- h. destruction and collection of objects of natural beauty such as limestone are not allowed;
- i. avoid unnecessary noise because it is detrimental to cave-dwelling organisms;
- j. avoid touching or playing with isolated pools in caves. These are important microhabitats and polluting by stepping on them, whether deliberately or

accidentally, will incur a major effect to the overall health of the cave ecosystem;

- k. always join the group and not wander alone while inside the cave; and
- l. keep up with the pace of the slowest cave visitor/s

C. After caving

C.1. Cave Guides should:

- a. ensure the headcount of the cave visitors;
- b. ensure that all waste bags are brought outside the cave; and
- c. wrap up or ask feedbacks from the cave visitors

VII. Sustainable Infrastructure

Caves for ecotourism demands careful planning for compatibility of infrastructure and facilities for the protection and conservation of caves and cave resources. Basic infrastructure and facilities are constructed to meet the needs of visitors but should have minimum impact on the environment. These structures should be designed in such a way that they are environmentally sensitive, practical and sustainable. Cave managers must realize that infrastructure and visitors will affect the integrity of the cave. There are existing methods and management strategies which minimize negative effects.

The installation process of ecologically sound infrastructure in passages of caves is rigorous. Materials to be used in infrastructure development should have the least possible impact on both the aesthetics of the cave and its underground environment. A good baseline data from the cave assessment, careful planning, vigilant maintenance and management should be observed by cave managers prior to the development of passages to sections open to visitors. Badly planned and designed infrastructure (lighting, pathways, ladders, etc.) will pose threats to cave, cave resources and visitors.

Cave managers should keep in mind that the primary purpose of installing infrastructure is to minimize the damage incurred to caves open for ecotourism while ensuring visitor safety and satisfaction. For example, pathways can be developed in certain passages of the cave so that a minimum distance is established between visitors and cave features to protect the walls, formations, hydrological features such as pools if present, as well as cave biota. Lighting may be installed to enhance the natural beauty of formations while showing their location to avoid visitors stepping over and/or touching them and not for the sole convenience of inexperienced visitors.

A. Lighting

Flora are found primarily in the entrance and twilight zones of the caves. Irresponsible installation of lamps in caves, promote the growth and encroachment of lamp flora into the darker areas of the cave. Lamp flora displaces the natural microflora of bacteria, fungi, and natural algae associated with moist, dark surfaces in caves (Olson, 2006). The growth of lamp flora in caves causes deterioration in the cave walls,

speleogens, and speleothems, destroying and hampering their natural beauty and formation.

Lighting should only be turned on during visiting hours and only for a limited time. Separate circuits should be used in cave lighting to control the lights, particularly when no visitors are present in an area. The electrical system should be installed in safe and well-balanced circuits, properly cabled and easily accessible, with the least damage incurred to the cave environment.

Lights in caves should be installed only in areas open to visitors. Lighting sources should be installed at a distance from any component of the cave to prevent the growth of lamp flora and damaging the formations and any rock paintings. For example, a minimum distance of 1 meter can be set to minimize lighting impacts in sections of a cave.

Lighting in caves should simulate the natural colors of walls and formations while ensuring visitor safety. However, lamps should not overpower the innate darkness of the cave interior.

Low power LEDs should be used as it emit less heat and are less intense than incandescent bulbs. Yellow colored lights at the 595nm wavelength are known inhibit the growth of lamp flora (Olson, 2006; Mulec and Kosi, 2009). LED strip lights, 12v LED downlights and other low-power technology are also recommended (Gillieson, 2011).

Pressurised paraffin lamps or kerosene lamps should not be used as lighting in caves, nor by visitors or cave guides. These emit smoke that deteriorate the cave and irritate cave biota.

B. Pathways and railings

Pathways and railings in caves should be meant for both visitor safety and to ensure the integrity of cave. The following materials are suggested for pathways and railings:

- a. New age materials/plastics – these materials have longevity, are low maintenance, and provide reduced impact on the cave floor.
- b. High grade stainless steel
- c. High quality plastics
- d. Fiberglass

The following materials should not be used in caves – these are corrosive, have short life spans (easy to rust or decay), prone to stain caves, are toxic to cave biota, and are unwieldy:

- a. Galvanized materials
- b. Dissimilar metals
- c. Non-ferrous materials (copper and related alloys)
- d. Iron and steel

- e. Wood
- f. Bitumen (Asphalt)

The use of concrete is also discouraged as once it is cast it is difficult to modify.

C. Gates

Gating should only be considered after conscientious survey and planning. Gates, if well planned, maintained, and managed will protect the cave and cave biota from unwanted visitors, without hampering the activities and survival of the latter. In special cases, gating may be allowed, such as for safety considerations and to safeguard cave resources. The design must take into consideration the animals that enter and leave the cave and possible effect to the airflow inside the cave which in turn can affect temperature, humidity, etc. *Annex A* provides the guidelines in gating caves and a flowchart to determine if the installation and management of an ecologically sound gate is feasible.

Cave managers should consider the following questions prior to the development of chamber or a passage:

- a. Has the cave, particularly its potential sites, been surveyed, assessed, and studied with good baseline data for infrastructure development?
- b. Will future studies and monitoring activities be conducted, particularly the efficacy of the installed infrastructure on minimizing visitor impacts?
- c. Are there any population of cave biota that will be disturbed or displaced, regardless of existing conservation status, abundance, and endemism, by the development of infrastructure?
- d. Are there any control mechanisms, aside from infrastructure, that can be implemented by cave managers to control visitor traffic and behavior?
- e. Will there be a budget in the monitoring, and maintenance of cave infrastructure and its impacts to the cave and its visitors, whether positive or negative?

VIII. Public Awareness

Promotion of environmental education and public awareness should be considered to improve conservation efforts. Printed materials, videos and other information materials should be disseminated to visitors and surrounding communities to achieve environmental awareness. In addition, signage can give important biological information and conservation messages hence, should be installed in strategic places.

IX. Monitoring

The monitoring tools that shall be prescribed in this issuance shall focus on the impacts of ecotourism and other human activities on cave and its resources being implemented by DENR and other concerned agencies. The information provided in the Cave Assessment

Report shall serve a reference to establish baseline information and be the basis for comparing subsequent monitoring results.

The recommended tools listed below were lifted from the Biodiversity Monitoring System developed by the DENR in collaboration with recognized experts and institutions. The detailed methodology for each tool is provided in *Annex B*. However, there other tools and methodologies that may be used for monitoring of specific populations and parameters (temperature, relative humidity, etc.). It is recommended that only experts in cave science and management be consulted should technical guidance be required.

Monitoring should be done annually. However, for caves with influx of visitors, monitoring should be done at least twice a year, preferably before and after the peak season of visitor arrival. Monitoring shall be led by the Cave Focal Person with the assistance of technical staff from the DENR Regional Offices, PENRO and CENRO especially those who have been trained on specific monitoring tools. Monitoring may involve local communities, other government agencies, local NGOs, academe and research institutions.

The DOT and DENR shall monitor the performance and number of duly accredited cave guides in the country and provide training programs whenever necessary.

The concerned DENR Regional Offices shall allocate funds for the conduct of monitoring activities pursuant to this guidelines.

X. Reporting

Cave focal person shall submit an annual monitoring report that will include the analyzed data and recommended actions to the concerned Regional Director and the BMB Director.

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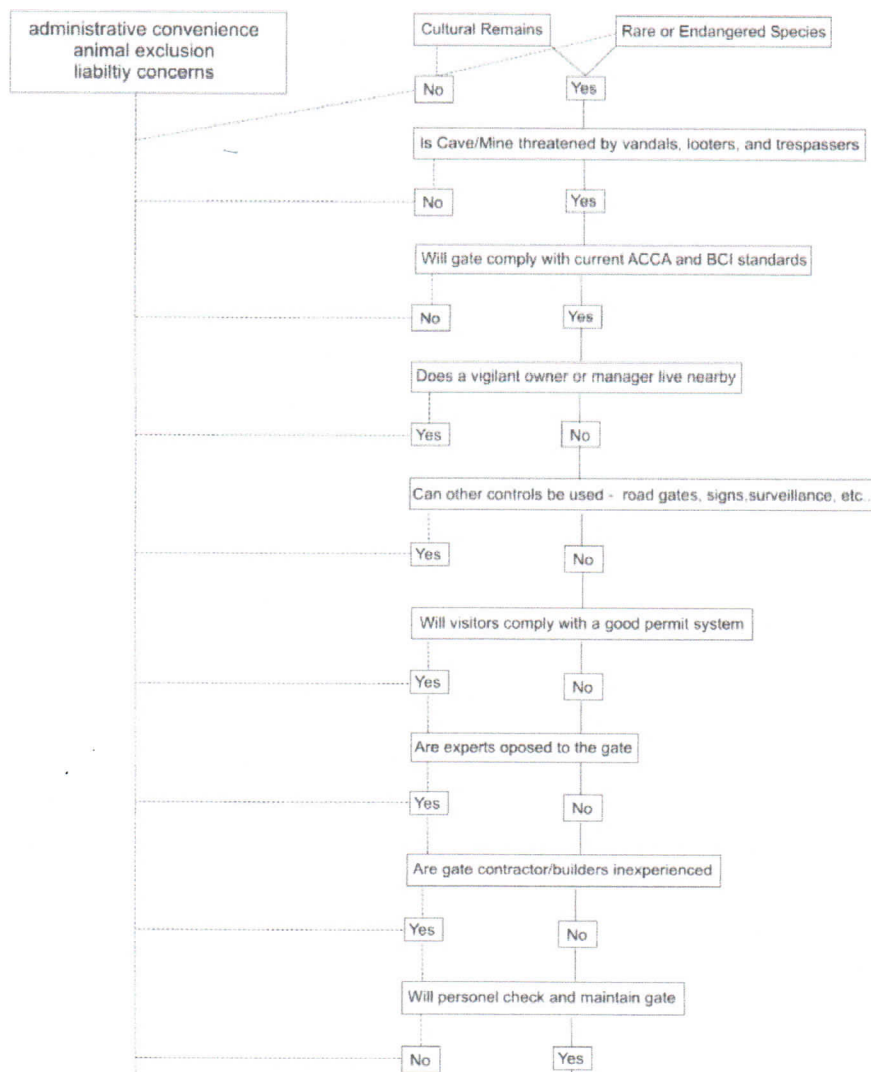
Annex A. Guidelines on Gating Caves (Lifted from *Agency Guide to Cave and Mine Gates* by Fant, J., Kennedy, J., Powers, R. and Elliott, W. 2009.)

I. Why gate?

The decision to gate is never easy. On the downside, there are the costs of construction and the disruption of the natural aesthetics. First and foremost, you must ask yourself what resources and threats are there. Are there cultural remains? Are there endangered species? Or are there inherent dangers present? If the answer to the first two questions is yes, to what point are they threatened? Can the site withstand minimal impact? If so, can signage alone detour the casual visitor? If you are making the decision to gate a cave based on inherent danger, there are many state laws which already grant protection from such visitation. You should consult your attorney before making your decision, as in some instances the gate may actually increase your liability. Abandoned mines, of course, are a very different story.

II. Guide Questions whether to proceed in gating caves.

Below is a simplified flowchart to aid in decision-making. In most cases there will be many more factors involved in making the final decision to gate a cave.



III. Placement of gates and variations on the standard design

Once the decision is made to proceed to protect the cave or mine with a gate, there are several designs based on specific criteria. One important criterion that is common to all gates is **placement**. Other criteria may be very specific to the type of resource which is to be protected. Much emphasis has been placed on the design of gates in which bats are present. These types of gates are also dependent upon what type of bat is present and the time of year. The standard airflow gate design (basic gate) has proven efficient in protecting other resources such as cultural sites and invertebrate biology.

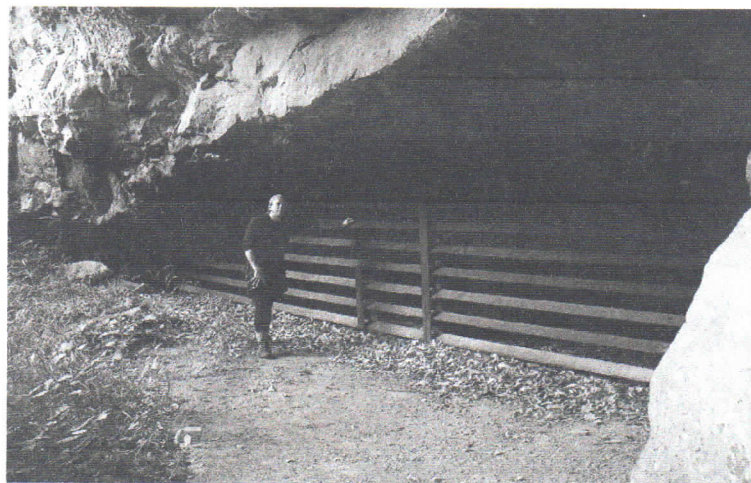
A. Placement

The gate should be placed in such an area that does not restrict airflow. This means that the smallest cross-sectional area should not be gated to save on material cost. Restricting the airflow causes changes in the temperature, pressure, and humidity levels deep into the cave or mine. These changes although small have great consequences on the ecosystem. If bats are present, gate placement should also not impede bat flight. Placement of the gate within easy to monitor areas is imperative, as any tampering can then be easily detected.

B. Basic Gate Design

The Basic Gate Design is a vertically placed flat grid of bars across the cave or mine passage. The spacing of the bars is critical to allow access of small bats and other small mammals, but not wide enough to allow human entry. The bars are constructed of 4" angle iron oriented apex up to maximize the airflow through the gate. Bars are oriented horizontally, with vertical supports spaced widely. The basic design is widely used even where there are no bats currently present.

Some caves or mines may require a variation of different types or styles of gates, but the key components of the Basic Gate should remain. A cave-gating specialist should be consulted during the initial stages of planning.



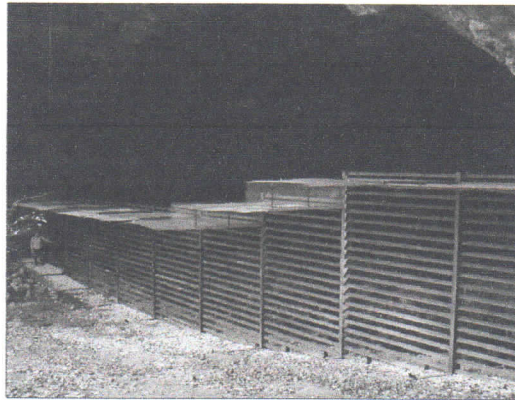
Picture 1 Basic Gate Design - Rocky Hollow Cave, Virginia - Photo Jerry Fant

C. Variations on the Basic Gate Design

1. Half Gate

The Half Gate, or Fly-over Gate, is a variation of the Basic Gate (sometimes also called a Full Gate). The Half Gate is designed for entrances or passages that have high vertical relief, typically over 20' (6m), and are used most often for large maternity colonies of bats. The bottom of the Half Gate consists of the bottom of a Basic Gate constructed high enough so that a ladder will not reach the top.

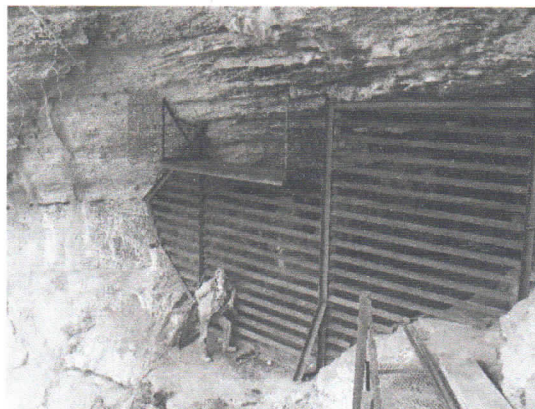
Special attention must be given to support columns, since they are not attached to the ceiling. Expanded metal mesh is then attached horizontally extending forward (and sometimes rearward, if warranted) to stop attempts at climbovers.



Picture 2. Half Gate, stepped to ground contour - Great Spirit Cave, Missouri - Photo Mike Slav

2. Basic Gate with Window

The Basic Gate with Window is also a variation on the standard gate design. The introduction of the window provides a larger protected flight space for bats, similar to the Half Gate or Chute Gate (described below). They can only be constructed in an entrance with an overhanging bluff, or well inside a large passage. The window is placed between a section of horizontal bars with expanded metal extending out on the bottom and sides to prevent persons from climbing over and into the site. This type of gate is also used where there are large numbers of bats present.



Picture 3. Basic Gate with Window - Bacon Cave, Virginia - Photo

3. Chute Gate

The chute gate is specifically used on caves or mines in which large numbers of bats inhabit for maternity or hibernacula, but for which the entrance configuration does not allow a Half Gate or Window Gate to be constructed. These gates are a design combination of a Basic Gate and an extended covered Window. The standard part of the gate will sometimes have a Bay Window (see below) added for a cantilever support for the Chute. The Chute extends beyond the Basic Gate at an angle to reach a height greater than a ladder will reach, thereby making entry more difficult for unauthorized persons while permitting unimpeded bat flight. The chute is covered with heavy gauge expanded metal. The size of the chute is determined by the expected number of bats and the physical size of the entrance.



Picture 4. Chute Gate – Grigsby Cave, Virginia – Photo Jerry Fant

4. Cupola Gate

Also sometimes called a “Cage Gate”, these gates are designed to protect vertical pit and mine entrances. A box of four Basic Gates is built around the vertical opening, a minimum of 4’ (1.2m) in height. The center top opening is then covered with additional angle iron or heavy gauge expanded metal. The height discourages vehicle traffic, and allows bats to slowly gain altitude and fly out the sides of the box, thus avoiding predators.



Picture 5. Cupola Gate, – Saltpetre Cave, Kentucky – Photo Jerry Fant

IV. Gate Design Specifications

The gate designs developed by the American Cave Conservation Association and Bat Conservation International have been in use for over twenty years. Much research into the integrity, airflow characteristics, and bat use has shown these to be the state of the art in modern cave and mine gating. For this reason major land management agencies and organizations have adopted these designs as their standard.

A. Basic Gating Materials (all gate material is of mild steel)

- Horizontal Bars: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron
- Stiffeners: 1½" x 1½" x $\frac{1}{4}$ " thick flanged angle iron
- Columns: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron
- Sill: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron
- Footers: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron
- Header Bar: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron
- Pins: 1" cold rolled steel round bar
- Pin Plate: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron *or* 6" x 6" x $\frac{3}{8}$ " thick flanged angle
- Hangers: 6" x 6" x $\frac{3}{8}$ " thick flanged angle iron
- Expanded metal: EM3 (4" x 2" diamond raised $\frac{3}{4}$ ")
- Bat Guard/Torsion Plate: 4" x $\frac{1}{4}$ " thick flat bar

For Half Gates, Windows, and Chutes (in addition to the above materials)

- Main support for expanded metal: 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron
- Additional support for expanded metal: 2" x 2" x $\frac{3}{8}$ " thick flanged angle
- Expanded metal: EM3 (4" x 2" diamond raised $\frac{3}{4}$ ")

B. Design

The gate shall have:

1. Weight-supporting bottom sill spanning the width of the passage, consisting of 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron;
2. Vertical support columns connected to the sill at the greatest width possible, but not exceeding 15' (4.6m);
3. Sill and columns rest on solid bedrock floor if possible. If not, they should rest on an expanded metal (EM3) skirt with at least 2 feet of EM3 both fore and aft of the gate;
4. Columns supported by 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron footers, which also serve to prevent lifting of the expanded metal;
5. Additional footers may be added as necessary to provide added security for the expanded metal skirt;
6. Vertical columns are ideally plumb to the longitudinal (front to back) axis of the cave, but can be off plumb on the perpendicular axis (side to side) if necessary to take advantage of wall attachment points, or to provide increased bat flight

space in irregular passages.

All columns and select horizontal bars are attached to the cave or mine walls with pins cut from 1" cold rolled steel round bar and a minimum of 8" long. They are pounded into 1" holes drilled into the solid bedrock walls, at least 4" deep and preferably 8" or more. The pins are then welded to Pin Plates cut from angle iron with a hole for the pin on one side, which is then welded to the gate itself.

The horizontal bars have two stiffeners inverted and placed inside the 4" x 4" flanged angle and welded to the 4" x 4" angle every three feet of its length. The completed horizontal bar is to be placed on 6" x 6" x $\frac{3}{8}$ " thick flanged angle iron hangers. The hangers are connected to the vertical support columns so that the height from the top of one horizontal bar is 5 $\frac{3}{4}$ " from the bottom of the bar above it.

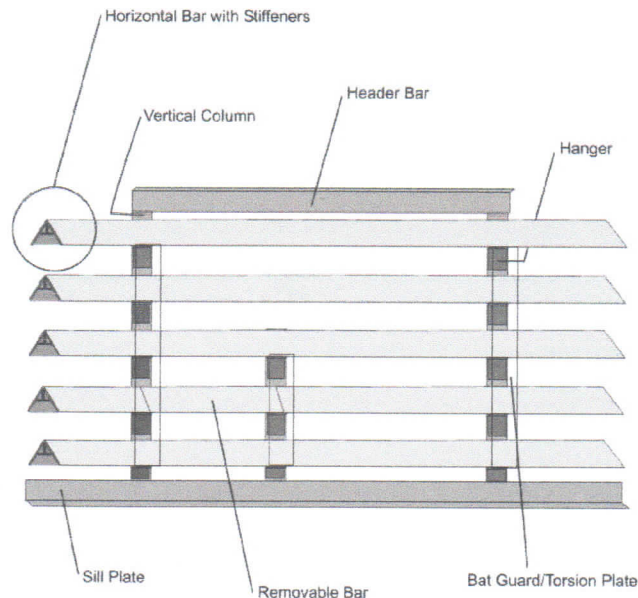
A 4" x 4" x $\frac{3}{8}$ " thick flanged angle iron header bar is welded to the top of the vertical support columns.

The bat guard/torsion plate is welded to the front side of the hangers on all vertical support columns.

The opening or door should be no less than 38" wide by 13" tall. This allows a loaded rescue litter to be passed through the gate in case of an emergency.

Removable bars (see diagram) are the most secure, but can be unwieldy for high-traffic use. In that case, a hinged door panel may be constructed as an alternative, but requires more care in engineering to assure long-term functionality without compromising the structural integrity or security of the gate.

Gates are typically left unpainted. The average projected life of a cave or mine gate is about 20 years. This can be substantially less in areas of extreme weathering, or when attached the gate is installed in a corrosive area. Gate designs continue to evolve, and gates need to be replaced as new and better options become available.



V. Post-gating actions

Scientific monitoring, such as temperature and other microclimate changes and biological inventories, should be carried out before and after gate building in order to have a yardstick by which to measure the effects of the gate, if any. If a bat site, it is critically important to document bat acceptance of the gate, and any behavioral changes, positive or negative, that occur as a result. Monitoring of the gate itself for signs of attempted illegal entry and vandalism must also be done on a regular basis to keep the site secure and prevent further damage, more expensive to repair.

We cannot state strongly enough the need for post-gate monitoring. Once the gate is completed the typical agency response is to assume their concerns over visitation and vandalism are over, and the site can then be blissfully ignored. This is not the case. No gate should be installed before a management plan has been developed for the resource. This management plan should include a monitoring schedule which includes the following:

1. **Periodic checks for structural stability.** Is the gate, and the bedrock to which it is attached, still structurally sound? Are erosion or freeze/thaw cycles affecting surrounding rock and jeopardizing site security? Are the steel or welds weathering faster than expected, resulting in weaknesses that can be easily exploited?
2. **Periodic checks for vandalism.** Has the gate been breached? Typical ways to circumvent the gate are digging under the gate, breaking the rock wall around the gate, digging another entrance, bending the bars, breaking a weld, cutting the bars, cutting the lock, or climbing over (if a Half Gate, Window Gate, or Chute Gate). In rare occasions, vandals will even forcibly remove the entire gate.
3. **Periodic checks for erosional effects from natural processes.** Is there an accumulation of debris building up around the gate? This can cause gates to fail when water-flow is encountered. It can also block natural airflow currents, which in turn disturb the microclimate.
4. **Periodic checks for opening functionality.** Locks need regular attention, requiring cleaning, lubrication (with graphite powder), or even replacement. Even McGard button head bolts need occasional lubrication, without which they become hard or even impossible to open. Doors and removable bars should be opened periodically, to ensure that the gate has not settled, rendering them inoperable.
5. **Periodic checks for biological integrity.** A site that has been gated to protect a population of bats or other animals, including invertebrates, must maintain a fairly narrow set of parameters to keep those populations healthy. If the gate is not ensuring those conditions, then it must quickly be modified, or even removed or replaced. Pre-gate monitoring of temperature, humidity, and animal abundance and distribution provides simple baseline data by which post-gate conditions can be compared. Pre-gate monitoring is highly recommended before any gate project is undertaken.

A breached gate that is not repaired rapidly is not protecting the resources from human threats. There are many natural forces that can also damage a gate, such as tree falls, rock falls, siltation, freezing and thawing, aging (rust), and running water. Checks should include close visual inspections as well as manual investigations. Vandals can be quite clever, sometimes cutting a bar, replacing it on the gate, and disguising it with mud to make it appear uncut. Often the breached area is away from the actual door or removable bar entry point, making it less likely to be noticed. Some vandals will go to extreme measures to destroy a gate or gain entry to a protected resource. A good monitoring schedule should be maintained monthly, or at a minimum of every six months in remote areas. Once a problem has been noted it should be repaired immediately.

Annex B. Suggested Tool in Monitoring Caves for Ecotourism (Tools were lifted from DENR-PAWB *Biodiversity Monitoring System Manual for Protected Areas*.2001)

A. FOCUS GROUP DISCUSSION METHOD

a. What is Focus Group Discussion Method?

This method comprises the establishment of a volunteer Community Monitoring Group of local people who are encouraged to collect information on a regular basis between quarterly Focus Group Discussions with PA staff.

Focus Group Discussions can generate very important information regarding trends in use of resources, trends in status of selected resources, and trends in the number of households benefiting from the use of resources. The information is mainly based on local communities' own perception of trends. Data gathered continuously from a number of representative communities can provide a valid picture of general trends.

For instance, changes in harvest volume per effort can indicate trends in abundance of resources. It can provide an early warning of over-harvesting situations which would threaten local communities' opportunities for sustained resource-use.

The method particularly encourages a constructive dialogue between PA staff and local communities on the status and management of the protected area. The PA communities will be directly involved in biodiversity monitoring. Consequently, the communities will become more aware of the need for biodiversity conservation. It is further anticipated that the communities involved agree on, and participate in, law enforcement and regulation of resource use.

b. Equipment to be used in Focus Group Discussion Method

- Identification guide
- Large sheets of paper
- Markers
- Snacks

c. Suitability of Focus Group Discussion Method

Useful on land and in freshwater and marine areas. In freshwater and marine areas, the method can be used to monitor the fishery as well as the status of wetland habitats.

d. Who conducts Focus Group Discussion Method?

This method should be undertaken by those PA staff who are not involved in enforcement activities in the same area (so as to encourage open discussion with

local people). Two persons are needed, one to facilitate discussions and one to record the minutes. One of them should be a permanent staff member. Skills in Participatory Rural Appraisal (PRA) method are an advantage. Two PA staff can be responsible for 4-6 Community Monitoring Groups, alongside other PA staff duties.

- e. How often should Focus Group Discussion Method be conducted?

A discussion meeting of two hours should be undertaken every quarter with the Community Monitoring Group (Focus Group Discussion). Once a year a meeting should be held with the village (barangay/sitio meeting).

- f. Where and when is Focus Group Discussion Method conducted?

Community-based biodiversity monitoring groups should ideally be set up in most settlements within the PA. However, it is suggested that in the initial stages of the Biodiversity Monitoring System you focus on:

- Communities living near areas of high conservation value,
- Communities with a relatively high dependence on forest or freshwater/marine products for their livelihood and subsistence. The more dependent they are, the more chance there is of people having valuable information on the resources,
- Communities thought to over-harvest areas of high conservation value, and
- Communities living in areas known to be the entry/exit points of resources.

- g. How to conduct Focus Group Discussion Method?

Focus Group Discussions are to be conducted in a pre-selected and permanent number of barangays or sitios. You should meet with barangay captains or other relevant community leaders to explain the objectives and activities of the monitoring system. You should stress the common interest of PA staff and local people in conservation and also mention the possible use of the monitoring data in a more sustained use of local natural resources.

Steps in conducting Focus Group Discussion

1. Make sure that you know the objective of the meeting (e.g., to discuss those resource uses and species that have been selected for monitoring by the Group) and how you want to conduct it (who will participate, proposed agenda, etc.).
2. Start the meeting by agreeing on the duration. Then agree on the order in which issues should be addressed. Use possible waiting time before all participants arrive for informal discussions and for taking a look in the members' notebooks. Show a strong interest in the members' notebooks.

3. Show the report you made from the last meeting and discuss it.
4. Go through the resource uses (that you already have decided to monitor) one by one:
 - let the members present their notes on the specific resource use,
 - agree on the combined numbers/quantities they have noted,
 - discuss the perceived trends in the resources,
 - discuss the trends at the level of extraction,
 - discuss significant changes,
 - discuss reasons for changes,
 - discuss problems and solutions.
5. Let the members present the list of priority species observed. Discuss changes in the observations, if any.
6. Discuss any other relevant matters with the Group that you or they think important.
7. Evaluate the session. See if anything needs to be improved.
8. Agree on the time and place of the next meeting. Draw the meeting to a close.

h. Analysis and Interpretation

1. Do the findings correspond to your expectations? Compare the findings with the results of monitoring in previous quarters. Have several Community Monitoring Groups reported the same problems? Are there perceived trends that are common to several Groups? If so, are the changes caused by a change in monitoring routines (for instance, when members of the Group begin farming instead of fishing, or when the composition of the Group changes). Or could they be caused by weather or other natural background conditions? Compare with the results of other methods. Are there indications of over-harvesting situations or consistent resource use problems that need to be discussed with the villagers at a community meeting?
2. Are there any changes that are so serious they need immediate attention from the PASu or CENRO in charge (such as big tree stumps indicating large-scale logging, or foreign fishing vessels using destructive fishing methods)?
3. If there are major changes not caused by a change in monitoring routines or natural background conditions then you should assess the reason for the change, the importance of the change and whether any management intervention is appropriate (Chapter 15). It might not be the amount of a resource harvested that has changed but perhaps the time it takes to harvest the resource, the number of people involved in harvesting a resource, or the number of dealers or middlemen
4. Present the findings to local people at community meetings and ask for their advice. Do they consider the findings relevant? Discuss possible

actions to be taken by the people themselves, the Protected Area Management Board and the Local Government Units

B. PHOTO DOCUMENTATION METHOD

a. What is Photo Documentation Method?

This method entails on-the-ground fixed point photographing of selected hillsides and ecotourism sites in priority forest blocks at regular intervals. Monitoring of major changes in forest cover and wetlands is best undertaken by comparing remote-sensing images (photos) taken from air planes or satellites at regular time intervals. However, these methods require funds and especially skilled staff, which are not locally available in the protected areas. Taking ground-based photos ('Photo Documentation'), on the other hand, is rather simple and inexpensive. It provides permanent documentation which does not depend on identification skills. This method is suited to monitor habitats and land-uses. It can tell if the size of important habitats is declining, and why. Photos can be taken of the exact areas where changes are likely to occur. Photos are very useful when presenting and discussing the results of biodiversity monitoring, as most people will be convinced by photographic documentation.

b. Equipment to be used for Photo Documentation Method

- DSLR camera with battery
- Compass
- Pencil
- Photo Documentation forms
- If possible, a tripod

When installing the method you need a topographic map. A GPS, and paint or other materials for permanently marking a site, would also be very useful.

c. Suitability of Photo Documentation Method

Useful in land, freshwater and marine areas, in undulating terrain such as hills, river valleys and along the shoreline of lakes, swamps and the coast.

d. Who conducts Photo Documentation Method?

This method should be undertaken by PA rangers, deputized forest guards and other staff with knowledge of the basic operations of a camera.

e. How often should Photo Documentation Method be conducted?

We recommend that you take photos every quarter of a year. You may later reduce this to once every year at view-points where no changes in land-use and habitats have occurred. Typically one PA staff or volunteer assigned will be responsible for up to 5 photo documentation sites.

f. Where and when is Photo Documentation Method conducted?

Photo Documentation sites should be established at view-points along routes and trails in seriously threatened areas (view-points are places where you can see large parts of the surrounding landscape from - not just the nearest few trees). In addition, a few sites should be established in areas without human use.

Steps in selecting and establishing photo documentation sites

1. Get hold of a topographical map and, if possible, vegetation/forest cover and land-use maps for the protected area.
2. Identify the most seriously threatened areas and ecotourism areas on the map.
3. Draw those routes and trails on the map that pass through the seriously threatened areas and ecotourism areas.
4. Mark view-points as possible photo documentation sites.
5. Select up to five of those view-points. Choose those which are accessible and from where you can overlook areas of forest where activities may occur within the next half year, or where disturbance recently occurred. Make sure you know the agreed land use for the area.
6. Go to the selected view-points and bring camera, compass, data sheet for establishment of photo documentation sites, topographic map, and if possible a GPS, paint or other tool for permanent marking of the site, and tripod.
7. Read the position and altitude using a GPS (and preferably an altimeter), and note the reading in the data sheet. If a GPS is not available, mark the approximate location of the site on your topographic map.
8. Use your compass to take a degree reading of the direction (camera angle) for each photo, and note the reading on the data sheet.
9. Take two identical photos for each camera angle.
10. Enter all the relevant information in your data sheet for the establishment of a photo documentation site. Very careful notes must be taken during establishment of photo sites.
11. Mark the exact site of the camera location with a permanent marker so that you or your colleagues can easily find the place again (e.g. paint on big stone or rock, not on grass or loose soils).
12. Draw the location of all your photo documentation sites on a topographic map.

g. How to take a photo for Photo Documentation Method?

1. Adjust the time (shutter speed) on the camera to 125 (1/125 of a second),
2. Look at what you want to photograph, not the sky above, through the camera. Use a tripod if available.

3. Adjust the aperture (lens opening) until the camera (light meter) indicates that the combination of shutter speed and aperture gives the correct amount of light.
4. Take two photos of the same view.
5. Enter all the relevant information in your data sheet for photo documentation.
6. Store and print the photos.
7. Make sure to note reference numbers that connect data sheet and prints.

h. Analysis and Interpretation

1. If there are major differences between the photos you should carefully analyze whether they are caused by a change in the natural background conditions. Perhaps the light, the cloud cover or the weather were different at the time when the photos were taken. Or maybe a difference is merely the result of the photos being taken in different seasons.
2. If there are major differences that are not caused by changes in the natural background conditions, then assess the importance of the differences. For instance, check whether the same differences occur in photos from other view-points.
3. If you consider that the differences are important, then try to identify the reason for the differences.
4. If differences are caused by a change in land-use or size of vegetation type blocks, you should compare this with the results of the other methods and assess whether any management intervention is appropriate.
5. See whether selected photos can serve as a basis for discussing management initiatives and for demonstration purposes in meetings with the PAMB and local communities. You may also want to quantify the differences by calculating how many photos show significant differences in vegetation or land-use, or even by estimating for each photo the proportion of the photographed land that has been subject to change.

C. FIELD DIARY METHOD

a. What is Field Diary Method?

This method comprises standardized recording of routine observations on resource use, habitat and wildlife in a simple pocketbook or data sheet during regular patrols in the PA. It encourages a routine of making daily accounts of observations.

All you need is to record in writing your observations when you are in the field. This will encourage you to be observant of changes in the use of PA resources, in the location of threats, and in the abundance of priority species in the PA.

b. Equipment to Field Diary Method

- Notebook
- Pencil
- Binoculars
- identification guide

c. Suitability of Field Diary Method

Useful in land, freshwater and marine areas.

d. Who conducts Field Diary Method?

Protected area rangers, deputized forest guards and the assigned BMS staff should use a Field Diary when they are in the field.

e. How often should Field Diary Method be conducted?

It is recommended that all PA staff undertake Field Diary reporting whenever they are in the field.

f. Where and when is Field Method Diary conducted?

A Field Diary is used on the regular patrol routes.

g. How to conduct Field Diary Method?

Steps in conducting Field Diary Method

1. Write your name, date and general locality (sitio/barangay) of the site you are visiting or patrolling. Always start your diary on a clean page.
2. When recording people encountered and their activities (reason why they are in the area), you should note:
 - the type of products gathered (orchids, rattan, fruits, leaves, shells, fish, etc.) and wildlife in their possession
 - their quantity
 - the use
 - the market price where possible

If you see people engaged in major unsustainable activities (mining, large-scale logging, destructive fishing, constructing buildings and roads without permits, large-scale extraction of resources without permit etc.), note the number of people and what they are doing.

3. When recording signs of people's presence in the PA, note the type of disturbance, such as:
 - cut/sawn logs,
 - discarded remains of hunted wildlife such as bird feathers and bat skins (count heads if possible),
 - sound of chainsaws (how many) or major cutting of trees,

- forest fires,
- smoke from kaingin,
- recent forest clearings (type of forest, size in hectares, and exact location), and
- large amounts of garbage.

If immediate management intervention is needed and you have a camera, take photos to document your observations.

4. When recording wildlife, note:
 - the type of record (seen, heard, tracks found),
 - the estimated numbers of individuals,
 - the habitat, and
 - the location

For unfamiliar species, it is desirable that a sketch of the animal be made emphasizing distinguishing features such as color, shape of beak, relative size (length or height), etc.

5. When recording physical changes (natural or caused by humans) in the landscape, such as eroded banks, landslides, new logging roads, mining exploration, quarrying or excavations, note the exact location of the observed disturbance. If you have a camera, take photos of the most important observations.
6. Second-hand information (what you are told, but you have not seen yourself) should also be noted in the Field Diary. Note always who gave the information. See the list of priority resource uses and species for your PA.
7. At the end of the day or after completion of each routine patrol round, a separate page in the Field Diary is allotted for a tally of all observations, arranged according to appropriate categories. The Field Diary data should be submitted to the PA Office immediately upon return from the field.

h. Analysis and interpretation

1. Are there indications of over-harvesting situations or consistent resource use problems that need to be discussed with the villagers at a community meeting?
2. Are there any observations that are so serious that they need immediate attention from the PASu or CENRO in charge?
3. Do the findings correspond to your expectations? Compare the results with results of monitoring in previous quarters. Are there major changes in numbers or distribution of records of resource uses and species?
4. If so, are you sure the changes are not caused by a change in patrol routines (change in sites visited, duration of time on each site, number of people talked to at each site, etc.)?
5. Or perhaps by weather, seasons or other natural background conditions? Compare with the results of the other methods.

6. If there are major changes not caused by a change in patrol routines or natural background conditions, then you should assess the reason for the change, the importance of the change and whether any management intervention is appropriate.

D. TRANSECT WALK METHOD

- a. What is Transect Walk Method?

The Transect Walk is somewhat similar to routine patrolling using the Field Diary. However, transects are permanent, demarcated routes where there are precise recommendations as to where to walk, when to walk and what to note, etc. The recommendations aim to ensure that new and earlier data sets are comparable.

- b. Equipment to be used for Transect Walk Method

- Binoculars,
- Watch
- identification guide
- Transect data sheet
- pencil
- drinking water
- snacks

When establishing the Transect Walk route, you will also need the following:

- topographic map
- compass,
- long string (50 or 100m)
- permanent marker (paint)
- bolo
- GPS, if possible

- c. Suitability of Transect Walk Method

Useful in land areas and in drier sections of freshwater and marine areas (such as inter-tidal areas, open lake shores and wetland meadows). In areas where it is impossible to walk, you can use a boat. The method is not suitable in very small PAs (less than 10 ha).

- d. Who conducts Transect Walk Method?

This method can best be undertaken by assigned BMS protected area staff with skills in identifying species. It can also be undertaken by regular patrolling staff with the same skills.

Each transect route should be surveyed by the same person every quarter. The person coordinating the conduct of Transect Walks in the protected area should also remain the same if at all possible.

- e. How often should Transect Walk Method be conducted?

Each Transect Walk route should be walked once every quarter within a defined two-week period. Typically one PA staff will be responsible for 3-5 Transect Walk routes.

- f. Where and when is Transect Walk Method conducted?

Transect routes should be established in the most seriously threatened areas of the PA, and in the areas most important for conservation and resource use by local people. It is advisable only to establish Transect routes where the species you need to monitor are present. Transect routes are best located along patrol routes in old growth (or old secondary) forest. Some routes should pass through areas with human use, others through areas with no or minimal human use.

Steps in conducting Transect Walk Method

1. Get hold of a topographical map and, if possible, vegetation and land-use maps for the particular area.
 2. Draw patrol routes and trails on the map.
 3. Are any patrolling routes passing through primary (old growth) forest? If so, they might be useful for transect surveys. Select several routes of 2-3 kilometers in different parts of the PA (preferably at different altitudes) and passing through primary (old growth) or good secondary forest. Use a small trail through closed forest (not a road with edge habitats). Avoid open areas with tall grass or bushes, and areas which are not safe to travel in when you are alone.
 4. Do a reconnaissance of the proposed routes to check that they are possible to walk (e.g. not too steep) and that they are located inside the PA.
- g. How to conduct Transect Walk Method?
1. You must walk the Transect Walk route with a constant rather slow speed. The distance between two 250 meter markers has to be walked in precisely 15 minutes (that is one kilometer covered every hour). Only short stops are permitted when identifying and noting. Otherwise the survey should not be disrupted, not even if illegal activities are observed. If a Transect Walk is disrupted, it should be undertaken again a few days later.
 2. You must always begin Transect Walks between 6 and 7 am and finish before 11 am.
 3. You should walk the transect alone. Different observers have different identification skills and different estimates of numbers. A less

experienced observer records less and data will show a false decline in biodiversity and resource use. Be as quiet as possible so as not to scare away wildlife.

4. Try to keep track of individuals or the flocks of wildlife species. If there are many individuals or flocks of a species there is a risk of double counting because of confusion from animals appearing in all directions. Species that move quietly between places where they sing or call might also cause confusion.

h. Analysis and interpretation

1. For each species or resource use, divide the sum by the length of your transect in kilometers. This will give you the frequency of your observations per kilometer ('relative abundance'). After a few years a graph can be made showing relative abundance of a species or resource use per quarter or per year.
2. Compare the results with results from the same transect in previous quarters (do not compare between different species or resource uses, or between different transect routes). Do the findings correspond with your expectations? Are there major changes in the relative abundance of any species or resource use?
3. If so, you first need to assess whether the data is sufficiently extensive. When there is little data, differences are often caused by chance alone. For example, if you flick a coin twice and see a head both times, you cannot be sure that there is a head on both sides of the coin. If you flick the same coin five times and still see a head every time, you are more sure that both sides have a head. However, it could still happen by chance.

It is the same with the monitoring data. The more data and the clearer change (or 'trend') they show, the more you can be sure that the trend is real.

Here are some examples for you to consider:

- absence of observations of a species or resource use does not necessarily mean absence of the species/resource use (if you do not record wild pigs in your transect, it does not mean that wild pigs are extirpated in your protected area);
 - a decrease in the number of observations of a species does not necessarily mean that the species is actually declining;
 - absence of a uniform trend or pattern in your data does not imply errors in your monitoring (it could just be because you have too few records to show real trends).
4. Secondly, you must assess whether the changes could have been caused by a change in monitoring routines (timing of the Transect Walk, abilities of the observer to detect wildlife species by their sounds, etc.), or a

change in staff (remember the Transect Walk should be surveyed by the same person every quarter).

5. Thirdly, you should assess whether the changes could have been caused by seasonal or annual change in the ability to record wildlife or resource use, or by weather or other natural background conditions.
6. If there are major changes that are not caused by chance (insufficient data), or a change in monitoring routines or staff, or natural background conditions, then you should assess the reason for the change, the importance of the change and whether any management intervention is appropriate.