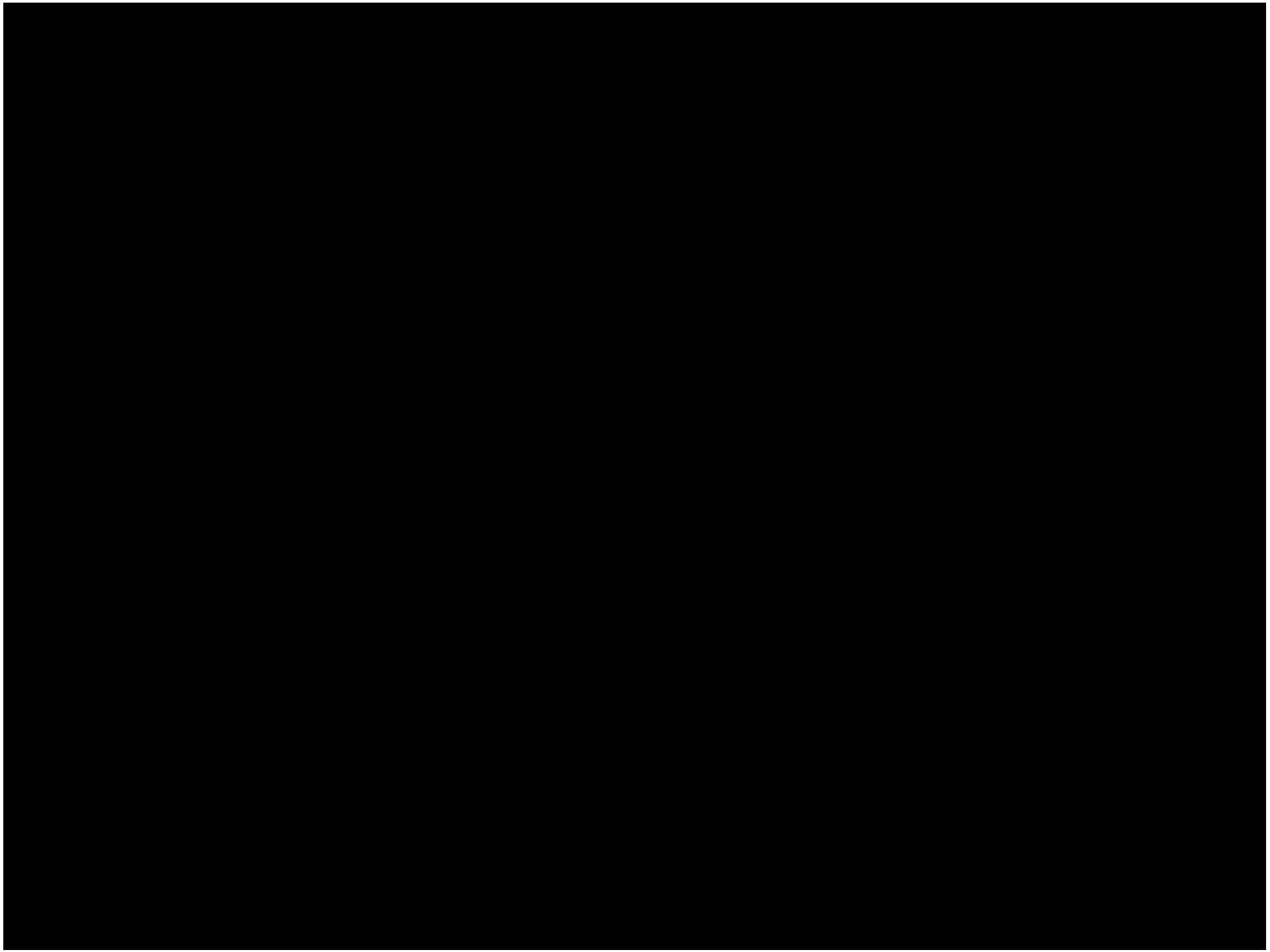


Principles and Guidelines of Cave Management

by

Dean Smart

EExploitation of Caves

PPrinciple – caves are used in many different ways and mmanagement needs vary according

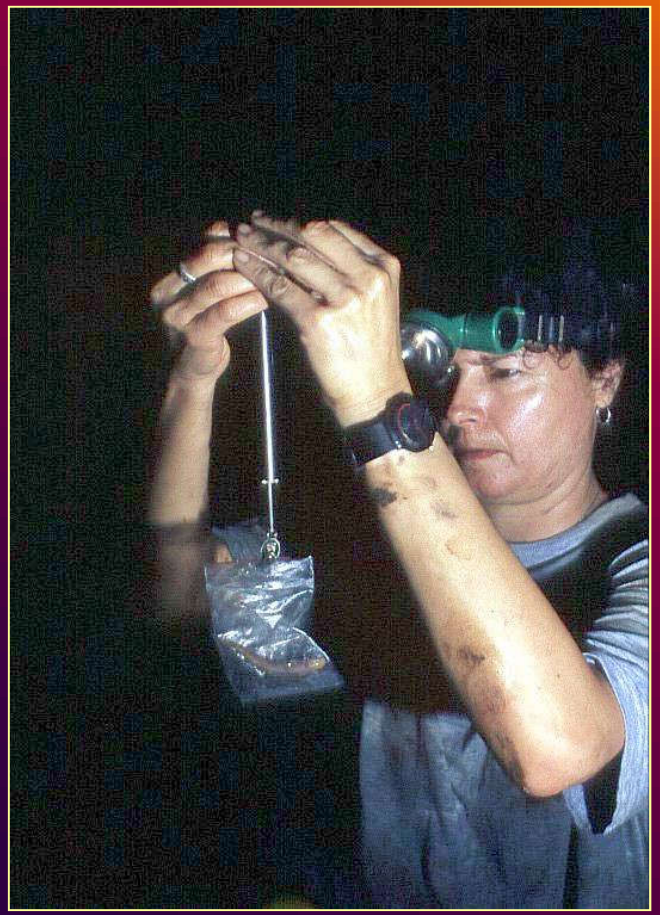
Historical and current use of caves in Southeast Asia:

- Tourist attractions
- Places of worship and meditation
- Burial sites
- Shelters
- Store houses
- Hiding places
- Thoroughfares
- Water supplies
- Sources of food – fish, bats
- Sources of guano and swiflet nests
- Sources of sediment and minerals – tin, rubies
- Industrial sites – stone tools
- Centres of knowledge, research and learning

Exploitation of Caves

Other uses from around the world:

- Wine cellars
- Mushroom farms
- Cheese factories
- Tuberculosis clinics
- Laboratories
- Fortresses
- Waste dumps
- Mass grave sites
- Hydroelectricity plants
- Manufacturing sites, e.g. rope
- Sources of saltpetre for gunpowder



Exploitation of Caves

Significance of caves:

Living museums – climate, relict species, fossils, archaeology, culture

Natural laboratories – human psychology, evolution, adaptation, ecology

Windows on the underworld – groundwater, geological exposures, archaeabacteria

Economic – water supplies, tourism, guano, swiflet nests, tin

Social – aesthetic, sporting, spiritual, shelter

Exploitation of Caves

Special characteristics of caves:

- Integral part of a wider landscape – karst
- Four dimensional – spatial ‘X, Y and Z’ plus time
- Origin by solution of the bedrock
- Rapid transmission of water
- Small, enclosed space
- Darkness
- Little exchange with the surface – stable environment
- Excellent preservation qualities
- Long ‘lifespan’
- Accumulate sediments, speleothems, bones, artifacts, etc
- Simple ecosystem with unusual fauna
- Low total energy budget
- Remarkably easy to disturb


ไปถ้ำ
TO CAVE

CCave Management

PPrinciple – maintain the integrity of caves tthrough protection, sustainable use and education

Cave management needs to:

Recognise the position of caves within the broader context of karst

Understand caves and the natural processes acting upon them

Appreciate the significance and vulnerability of caves

Understand potential threats and the ways in which damage can be prevented or reduced

Realise that all caves are different and that management must adapt to the needs of each cave

CCave Management

Aims of cave management:

Maintain the natural processes and environment of caves

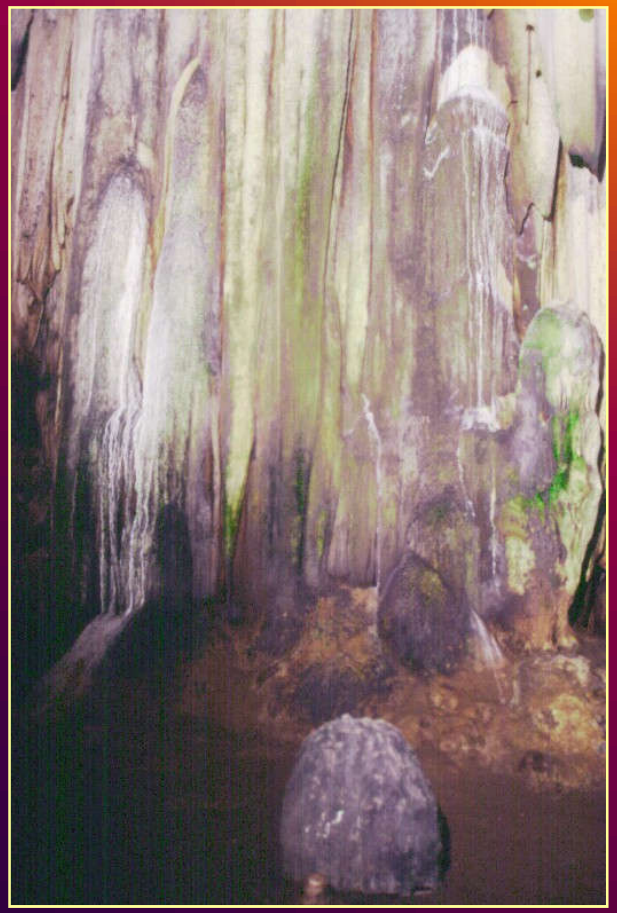
Protect the natural and cultural features of caves

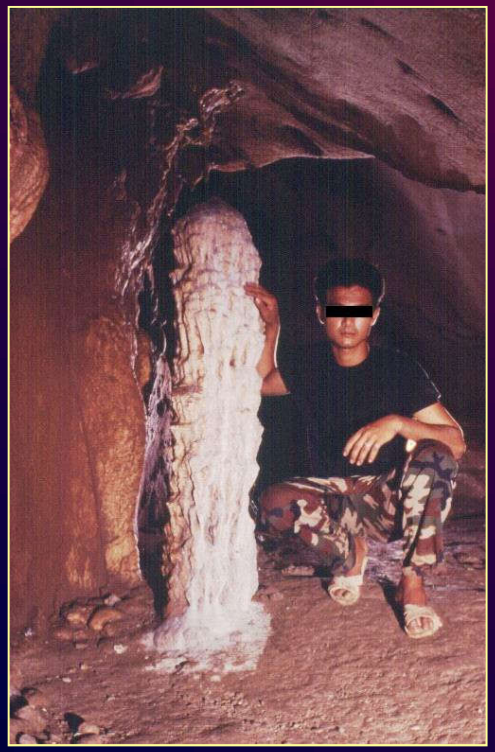
Detect deterioration and take action if necessary

Allow people to enjoy caves and improve their appreciation and understanding

Provide economic and social benefits

Actively collect data





Cave management classification in Thailand (Smart, 2000):

Category 1: **Public Access Caves**
- 1.1 Eco-tourism
- 1.2 Tourism
- 1.3 Temple

Category 2: **Special Purpose Sites ***
- 2.1 Comparison sites
- 2.2 Sites of special natural and/or cultural value
- 2.3 Dangerous sites
- 2.4 Human industry sites

Category 3: **Wild (& unclassified)**
- 3.1 Caves classified as wild
- 3.2 Unclassified caves

* The classification for 'special purpose' sites also needs to state the reason for inclusion in this category, e.g. Tham Hud – 2.3 (bad air), Tham Khao Chong Phran – 2.4 (bat guano).

SSite Selection

PPrinciple – correct use of a cave can minimise many problems

Apply the cave to the use and *not* the use to the cave:

Assess the cave to determine what it is suitable for, if anything

Energy level – low, high and ultra-high

Location, location and location

Restore and redevelop old public access caves before developing new ones

Different parts of the same cave may be used in different ways

CCave restoration

Principle – repair and clean the damage caused by people

Some techniques for cave restoration:

Assess the state of the damage and formulate a plan
Remove all rubbish and old, unused development structures
Old, organic material – remove gradually and not all at once
Freshly broken speleothems – stick back together with epoxy glue and stainless steel pins
Large, robust speleothems – brush or scrub gently with water. Pressurised water jets can be used for large areas.
Small, delicate speleothems – gently brush or leave alone
Soot and non-paint graffiti – spray or gently scrub off with water
Paint – dissolve with sulphuric acid solution and rinse thoroughly
Lampenflora – scrub with 5.25% solution Sodium Hypochlorite (bleach) and rinse thoroughly
Algae – spray with undiluted bleach, leave for 3-5 days and rinse
Removing waste from the cave – dust pans, waste water drains

PProtective strategies for caves

Secrecy

Principle – simply not telling anybody about a particular cave iis a form of protection

Secrecy has the following advantages:

Simple, cheap and quite effective in the short term

No public interest = no pressure to develop the cave

Visitor numbers will be very limited

Protective strategies for caves

Secrecy

Disadvantages of secrecy:

Other people will be unaware of the caves' significance and that their actions could cause unintentional damage

The data may be lost due to computer failure, fire, etc.

The information will get out sooner or later

Remember – misinformation and lies cause confusion for everybody

Protective strategies for caves

Gating

Principle – keep casual visitors out of sensitive caves

Gates can be used only after all other options have been exhausted:

Gates can severely impact the cave environment by changing air and water movements

Gates can restrict animal movement in and out of the cave

Some species of bat cannot tolerate gates

Large bat colonies cannot pass through gates

Protective strategies for caves

Gating

Gate design (if there is no alternative):

- A fence encircling the entire entrance area is better
- Gates need to be strong and lockable
- The gate must be openable from inside without a key (emergency)
- Avoid changing the cross-sectional shape of the passage
- Leave a hole for the passage of porcupines, rats, crickets, etc
- Bar spacing for a bat gate should be at least 15cm vertical and 120cm horizontal
- Some bats prefer a gate placed inside the entrance where it is dark and predators are fewer
- Airtight doors are needed for entrances that were naturally sealed before being dug open
- Put up a sign explaining how to gain permission to enter the cave

Protective strategies for caves

Permit systems

Principle – limit visitation in sensitive caves to people with permission only

The way a permit system works:

The cave is closed off to casual visitation

People wishing to visit the cave apply for permission to enter

The manager assesses the application and either: grants permission, issues a permit and arranges access; or denies permission.

The permit may cover one trip or a series of trips

Protective strategies for caves

Permit systems

Limiting permission, for example, to people who:

- Have a recognised qualification
- Have previously demonstrated a responsible attitude
- Have a legitimate reason to enter – surveying, research, monitoring, cleaning, etc

Protective strategies for caves

Permit systems

Advantages of permit systems:

- Very effective for limiting and monitoring visitors
- Visitors follow minimal impact codes more closely (violators can be easily identified and not granted permission again)
- Overcrowding can be reduced
- Good opportunity to spread conservation messages

Disadvantages:

- Increased bureaucracy
- Higher level of protection needed to prevent casual visitors
- There will always be people who try to ‘sneak’ in – sometimes successfully

Strategies for sustainable use of caves

Carrying Capacity & VIM

Principle – people are not cows

Cave managers no longer use ‘carrying capacity’:

Carrying capacity was originated by farmers wanting to put the optimum number of cows on each unit area of field

Managers took the idea and turned it into a limit on the number of people allowed to visit a site

All visitors to *all* caves cause impacts, so the carrying capacity of *all* caves is zero

Cave managers accept that impacts are inevitable and try to minimise them

Strategies for sustainable use of caves

Carrying Capacity & VIM

Visitor Impact Model (VIM):

Define objectives for the conservation of the cave

Create a scheme for monitoring impacts

Apply management practices to achieve the objectives if they are not reached

Minimal impact visitation codes:

Minimal Impact Caving Code, 1995 – Australian Speleological Federation (summarised):

1 EVERY caving trip has an impact. Is the trip into the cave necessary? Is there an alternative, less vulnerable cave that can be visited?
2 The trip leader should have prior experience and knowledge of the cave, its sensitive features, anchor points and reduce the need for unnecessary exploration.
3 Move slowly.
4 Beginners should be close to an experienced caver who can help when required.
5 Keep the team size small – 4 is a good number.
6 Move as a team and help each other. Do not split up unless it reduces impacts. Move at the speed of the slowest team member.
7 Constantly watch your head AND the heads of your team members. Warn them before any damage is likely to happen.
8 Keep caving packs small or do not use them at all.
9 Do not wander around the cave unnecessarily.
10 Stay on marked or obvious paths. If there is no path – define one.
11 Learn to recognise deposits and features that can be damaged by walking or crawling on them.
12 Take care when placing hands and feet.
13 Wash your caving clothes regularly to reduce the spread of fungi and bacteria between caves.
14 If a site is obviously being impacted, find an alternative route in which impacts will be lower. Inform the management of the damage and the alternative.
15 Carry in-cave marking materials to replace missing markers and tape off sensitive areas or areas being damaged. Inform the management of the damage.
16 If it is necessary to walk on flowstone, remove dirty boots and clothing or DO NOT proceed. Return later with better equipment.
17 Treat cave biota with respect. Watch out for them, avoid damaging them or their traps and avoid directly lighting them.
18 Bone material found on existing or proposed paths should be moved to a safer location. Collection should only be undertaken with appropriate permission.
19 Eating food in a cave should be done over a plastic sheet to catch falling food fragments and then removed.
20 Ensure that all foreign matter is removed from caves including human waste.
21 Protect natural anchor points with cloth, carpet or a caving pack. Only use bolts where natural anchor points are inappropriate.
22 CAVE SOFTLY!

Minimal Impact Caving Code – National Speleological Society, USA:

1 **Take nothing but photographs**

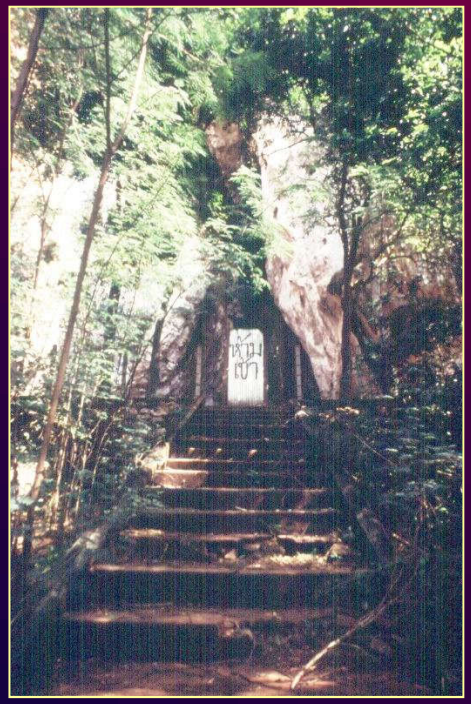
Do not move or remove rocks, sediments, speleothems, animals, fossils, archaeological remains, religious and cultural artifacts, etc.
(N.B. The light from flashes can disturb bats and other cave fauna)

2 **Leave nothing but footprints**

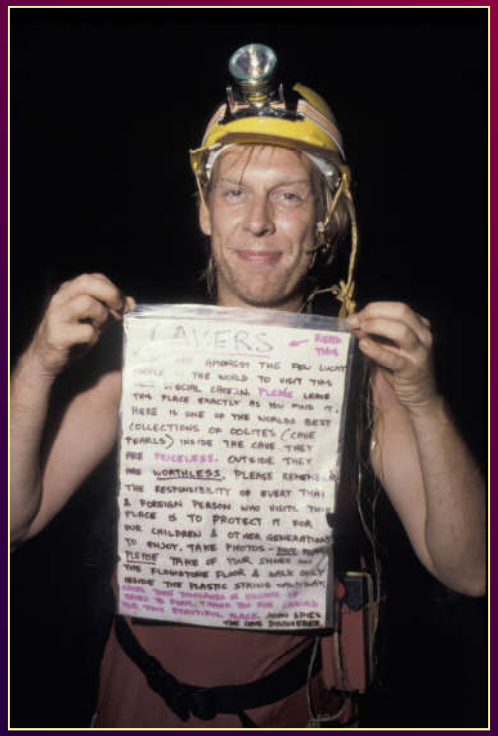
Do not leave spent batteries or calcium carbide, candle wax, litter, food and drink scraps, graffiti, bodily wastes, etc.
(N.B. Walk along a single, narrow footpath. Remove dirty shoes to walk on delicate floors.)

3 **Kill nothing but time**

Do not disturb, harm or kill any cave animal – invertebrate, fish, bat, snake, etc. Do not smoke cigarettes, light fires, touch speleothems, etc.
(N.B. Do not spend too long in any one place. Body heat and breathing can alter the cave environment.)




TAKE NOTHING BUT PICTURES
LEAVE NOTHING BUT FOOTPRINTS ON PATH


CAVERS
AMONGST THE FEW LIGHT
THE WORLD TO VISIT THIS
THE PLACE EXACTLY AS YOU FIND IT.
HERE IS ONE OF THE WORLDS BEST
(COLLECTIONS OF OOLITES (CAVE
PEARLS) INSIDE THE CAVE THEY
ARE PRICELESS. OUTSIDE THEY
ARE WORTHLESS. PLEASE REMEM
THE RESPONSIBILITY OF EVERY THAI
& FOREIGN PERSON WHO VISITS THIS
PLACE IS TO PROTECT IT FOR
OUR CHILDREN & OTHER GENERATIONS
TO ENJOY. TAKE PHOTOS -
TAKE OF YOUR SHOES
THE BOARDWALK FLOOR & WALK ONLY
INSIDE THE PLASTIC STRING

Strategies for sustainable use of caves

Resource extraction

Principle – resource extraction from caves can be sustainable if done properly

Reasons for allowing resource extraction:

Many people may already rely upon the resource

The resource may have great economic value

If the benefits go to the local community, other pressures such as hunting and deforestation can be reduced

Strategies for sustainable use of caves

Resource extraction

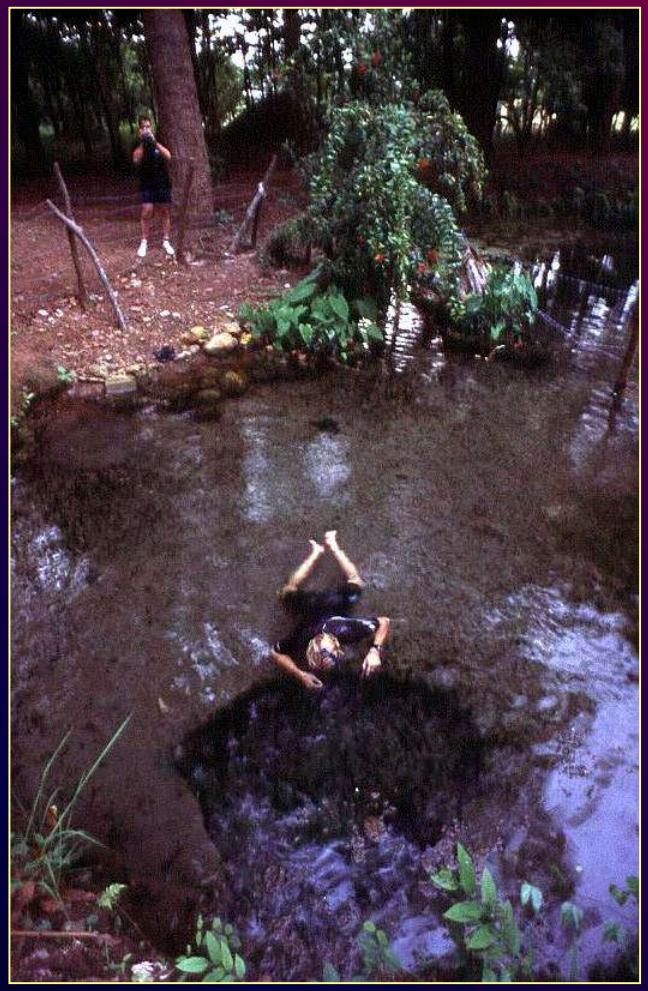
Water supply:

Assess the quantity and quality of the supply

Determine the source (catchment area)

Maintain water quality by protecting the catchment area

Building dams at cave entrances or inside caves will drown the cave and may increase flooding risk in catchment areas



Strategies for sustainable use of caves

Resource extraction

Guano extraction:

- Assess the deposit size and rate of replenishment
- During extraction disturb the bats as little as possible
- Extract only fresh guano
- Extract infrequently and at night
- Extracting during the breeding season can be especially damaging
- Always leave some guano for the other cave fauna
- Monitor the bat population
- Review existing permit systems and change if necessary. Create a permit system if there isn't one

Strategies for sustainable use of caves

Resource extraction

Swiftlet nests:

- Determine the species and the size of the colony
- During extraction disturb the birds as little as possible
- Harvest once before egg-laying and have a closed season of 140-160 days to allow breeding (depends on species)
- Nests with eggs or live young should be left untouched
- Extract during the day
- Promote the use of empty buildings instead of caves
- Monitor the bird population
- Review existing permit systems and change if necessary. Create a permit system if there isn't one

Strategies for sustainable use of caves

Monitoring

Principle – watch for increased impacts and deterioration

To monitor impacts:

- Create a baseline of data – visual inspection, photographic, indicator species, temp/humidity, water quality, management, etc.
- Collect baseline data for several years if possible
- Use the same locations, equipment, camera, film, etc. for monitoring as used for the baseline
- More frequent monitoring is needed in heavily visited caves or where impacts are seen to be worsening
- After management begins, monitor visitor nationality, numbers and opinion; management changes, guano extracted, etc.
- Monitor comparison sites as well!
- If deterioration is detected – repair and reduce further impacts

Cave tourism

Principle – entertain and educate tourists in a pleasing, interesting, safe and conservation-minded manner

Tourist cave design

Principle – designing tourist caves requires careful thought

Some general considerations:

- Careful site selection is essential
- The most suitable cave for tourism is not necessarily the most beautiful
- Create a detailed management plan – significance, vulnerability, restoration, development, infrastructure, lighting, role of guides, interpretation, monitoring, etc.
- Happy tourists = happy managers

Cave tourism

Materials

Principle – use cave-friendly materials

Materials should be:

- High quality to reduce the chance of impurities
- Non-toxic, non-rusting and non-biodegradable
- Chemically inert
- Strong

Comparison of some commonly used cave infrastructure materials:

Use	Good material	Poor material
Trail	Recycled plastic wood, concrete blocks/slabs, unglazed ceramic tiles	Natural cave floor, poured concrete, wood, glazed or polished tiles
Railings	Recycled plastic wood Stainless steel	Zinc plated steel Wood
Fill	Pure, clean silica sand	Sand with impurities Cave sediment
Fittings, bolts, etc	Stainless steel	Steel
Lights	Plastic & waterproof	Metal & not waterproof
Cables	Plastic coated	Rubber coated
Switch boxes	Plastic & waterproof	Metal & not waterproof
Pipes	Plastic	Metal Rubber
Signs	Recycled plastic wood Perspex	Wood

Cave tourism

Trails

Principle – walking trails are perhaps the single most important piece of infrastructure in a tourist cave

Walking trails:

Protect the natural cave floor

Create appreciation for the natural cave floor

Provide a safe, comfortable walking surface

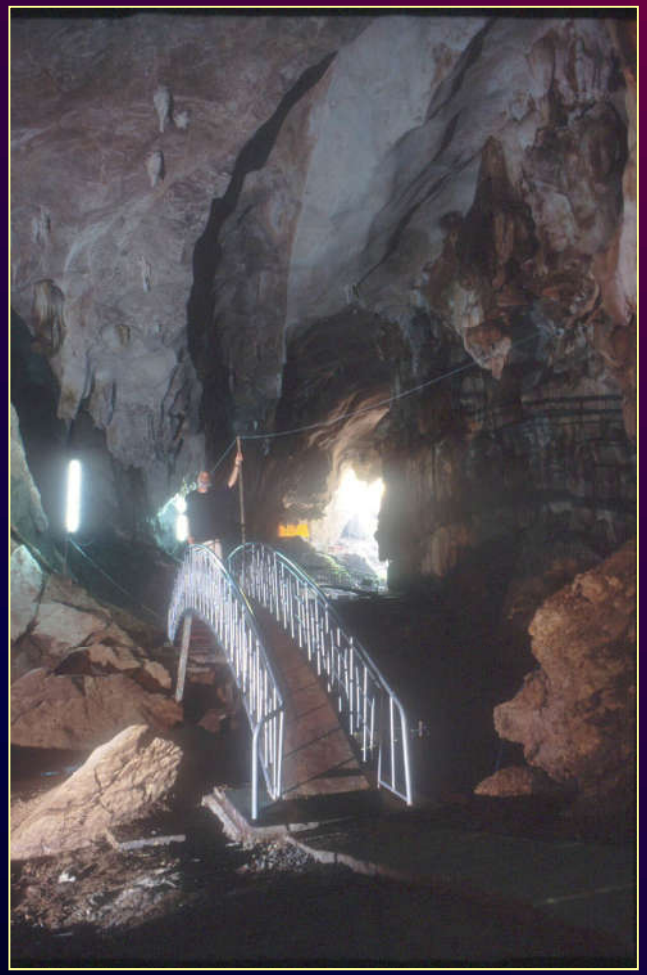
Restrict the movement of tourists – keep them away from fragile features, dangerous areas, etc

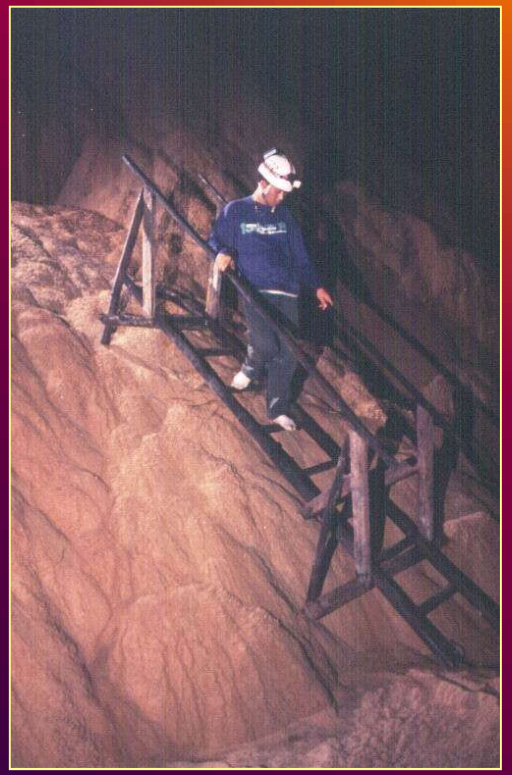
Cave tourism

Trails

Trail design concepts:

- The natural cave floor is unsuitable – trampling damage, slippery, uneven, etc.
- Build above or on top of the floor and not down into it
- Raised boardwalks are best, but may be expensive
- Trails can hide electric cables, water pipes and other facilities
- Railings help to keep tourists on the trail
- Raised sides provide little benefit
- Non-slip surface
- Steps should be minimised, use slopes where possible
- Where steps are needed, each should be less than 15cm in height, preferably 10cm
- Circular routes are more interesting than straight 'in and out'





Cave tourism

Lighting

Principle – display the cave and its features and provide light for walking safely

Problems with artificial lighting in caves:

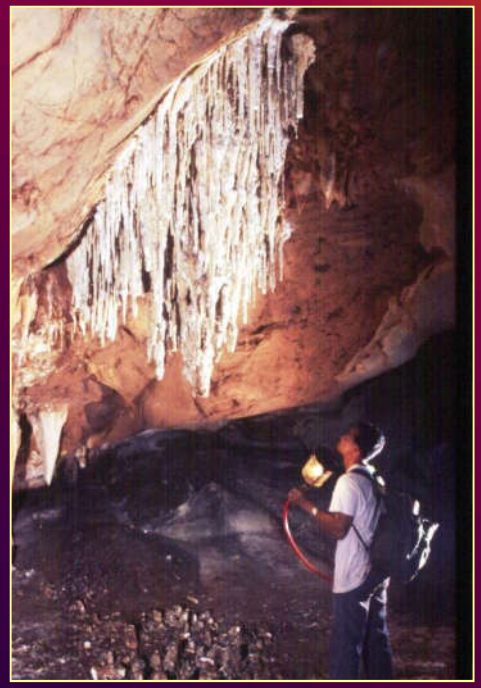
- Electricity and the dampness of caves is a dangerous combination
- Heat, humidity and air movement changes
- Lampenflora
- Many caves are over-lit (too many lights and/or too bright)

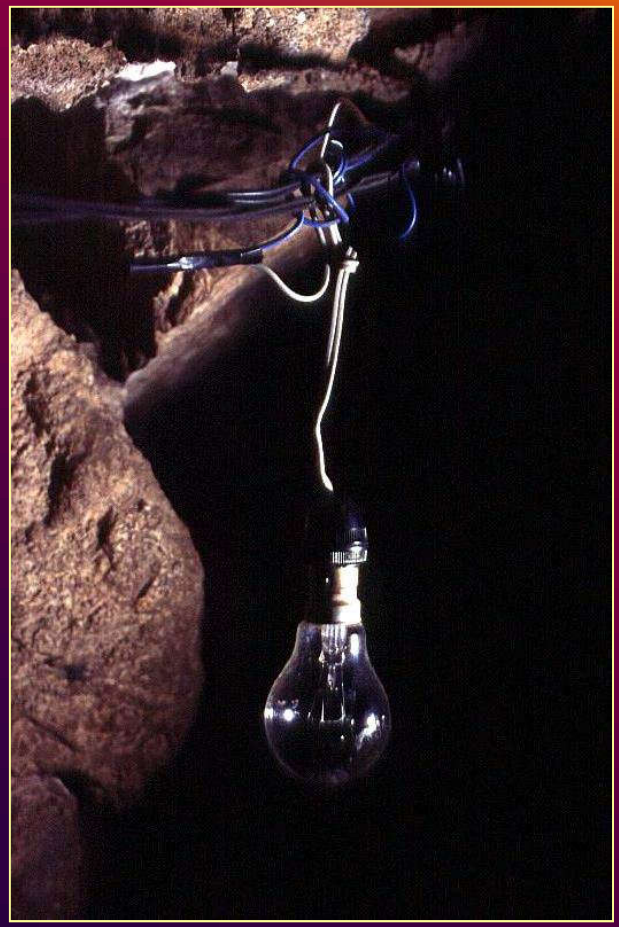
Cave tourism

Lighting

Artificial lighting systems in caves:

- 12-volts is safer and cooler than 120 or 240 volts
- Consider LED's or a handheld spotlight
- Use a variety of spots and wide spread lights for visual effect
- Leave non-interesting parts of the cave in the dark
- Light the trail adequately, but leave the bordering floor areas dark
- Aim the light away from tourists' eyes
- White lights show off the caves' natural colours
- Switch on and off for visual effect and to reduce impacts
- Need to be well maintained
- Emergency trail lights running off an independent power supply (batteries)
- Backlighting perspex information signs





Cave tourism

Guides

Principle – guides are much more than interpreters

Guides:

- Very, very difficult job to do well
- Interact with tourists
- Keep control of tourists
- Interpret the cave
- Motivated, adaptable, polite and charismatic guides = satisfied tourists

Cave tourism

Guides

Reasons for having guides:

- The cave is better protected through tourist control
- The tourism experience is more enjoyable than ‘self-guided’
- More information can be related than with signs

Considerations for guides:

- Guide to tourist ratio = 1 guide for every 6-8 tourists is good
- The people at the back of a group are the most liable to cause vandalism
- Being a part of the group is better than being a leader

Cave tourism

Interpretation

Principle – educate tourists about the cave and its values

Interpretation:

- Give tourists a sense of appreciation and understanding
- Use concepts rather than facts
- Keep it simple and stupid (KISS)
- Be accurate
- Be subtle
- Avoid fantasy

Cave tourism

Interpretation

Possible interpretation topics for a general cave tour (not in any order except for the first and last):

Hello and welcome
Who discovered the cave and when?
Role of water, air, soil, rock and time
Shape of the cave
Speleothems
Cave animals
History
Conservation of the cave
Goodbye and please come again

Cave tourism

Interpretation

Considerations for improving tourist experience through interpretation:

- Reciting scripts word-for-word is boring
- Let the guides choose what to interpret and at what level
- Let the guides introduce their own ideas
- Avoid bombarding visitors with too much information
- Offer specialist tours, e.g. geology, biology, archaeology
- Let tourists ask questions
- Lighting and trail design is an important part of interpretation
- Use language(s) that suit the majority of the tourists

Remember – the knowledge gained by tourists at your cave will be taken onto future caves that they visit. If the knowledge gained is conservation based, other caves will benefit.

Cave tourism

Other considerations

Other things that might be considered are:

- Tourists do not need to see the entire cave – leave some areas natural and undeveloped
- Tour times of about 30 minutes are good, no longer than 1 hour
- At some point it *will* become necessary to clean the cave – install water pipes and a drainage system
- Infrastructure *will* need to be removed or replaced in the future – consider using 'knockdown' structures
- What about a boat trip?
- What about music?
- If there are a series of caves in the same area, vary the visitor experience in each cave
- Monitor the quality of visitor experience
- Advertise!


PETZL


Thank you