CAVES LAKE HORNE PROVINCIAL PARK

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#### INTRODUCTION

The purpose of this manual is to provide Parks and Outdoor Recreation staff with background information relative to Horne Lake Caves Provincial Park. The manual consists of three sections. The first deals with caves and caving in general and is intended to introduce staff that are unfamiliar with the topic to cave formations and cave forming processes. Also, the hazards and precautions of cave exploration are identified so that an unequiped or inexperienced party can be recognized. The second section describes cave management and interpretation in British Columbia. It is provided to familiarize staff with the problems and limitations of local cave management. The final section of the manual provides interpretive information on the Horne Lake Caves. It is intended to assist staff confronted with questions about the caves.



LIMESTONE CAVES

IN BRITISH COLUMBIA

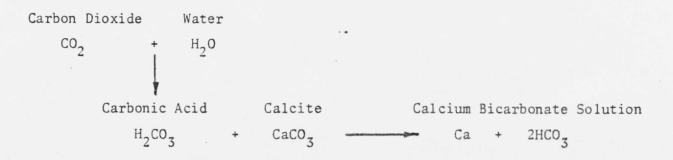
#### 1.0 FORMATION OF LIMESTONE CAVES

### Limestone

Limestone is a sedimentary rock made up of the calcareous skeletons of marine plants and animals precipitated from ancient seas. Marine life such as corals, worms, mollusks, and small crustations contributed to the layers of particles that made up the primordial ocean floor. (Zim and Shaffer, 1957) Later, these particles were compacted under pressure and cemented into solid rock. (Moore and Sullivan, 1978) Because limestone is formed in layers, it consists of horizontal beds of rock separated by thin planes of weakness called bedding planes. Also, as mountain building forces uplifted the limestone beds, vertical cracks, called joints, appeared in the horizontally layered rock. (McClurg, 1973) This system of joints and bedding planes is not only responsible for the characteristic blocky appearance of limestone in a landscape, but also provides an exposed surface on which water can flow and erode its path.

### Water and Limestone

Limestone consists, largely, of the mineral calcite (Moore and Sullivan. 1978) which is highly soluble in acidic water. (Zim and Shaffer, 1957) The acid responsible for this solution is carbonic acid, which is produced by decaying soil humus and water. (McClurg, 1973) When limestone comes into contact with carbonic acid, calcite is carried away in solution in the form of calcium bicarbonate. (Jennings, 1971) This process can be illustrated by the following formula:



In this manner, joints and bedding planes are enlarged to form the systems of underground chambers and passageways that occur in the limestone landscape.

The solution process is complimented by another reaction to form the features found in limestone caves. Water, carrying calcium bicarbonate, releases carbon dioxide to the cave air which contains a much lower concentration of the gas than does soil air. As the water releases carbon dioxide, it loses its ability to hold calcium bicarbonate in solution. This reaction is the reverse of the solution process and is illustrated by the following chemical formula:

Calcium Bicarbonate Solution Carbon Dioxide Calcite Water
$$Ca + 2HCO_3 - CO_2 + CaCO_3 + H_2O$$

When calcite is released from solution, it is deposited on the ceilings, floors, and walls of a cave, forming the stalactite, stalagmite, and flowstone formations unique to the cave environment. (Moore and Sullivan, 1978) In British Columbia, this process occurs at a rate of about one cubic centimetre a century. (Whitfield, 1980)

### 2.0 LOCATION OF LIMESTONE CAVES IN BRITISH COLUMBIA

British Columbia contains an estimated 600 to 700 explored caves. There exists no complete cave inventory of the province because most exploration has been performed in relatively small areas by caving clubs or persons associated with these organizations. Information is not usually released because these groups are primarily concerned with the conservation of cave environments. However, most known caves are located on Vancouver Island where an abundance of surface limestone and an extensive network of forest roads are conducive to the formation and discovery of limestone caves. (British Columbia Ministry of Lands, Parks and Housing, 1980). The distribution of well known caves in British Columbia is illustrated in figure 1.

#### 3.0 FEATURES OF LIMESTONE CAVES

### Cave formations

Cave formations generally fall into one of two basic categories: those

that have been formed by the solution process (speleogens) and those that have been formed by the deposition process (speleothems). Formations of solution that exist in British Columbia are phreatic tubes, scallops, and boxwork.

Phreatic Tubes - Phreatic formations are created when water completely fills a chamber or passageway in a limestone bed. This situation exists below the water table, in the case of a perched water table, or when water flows under pressure. Water under pressure will cut a long, rounded passageway, usually where a joint and a bedding plane meet. This passageway is a phreatic tube. (Waltham, 1974)

Scallops - Scallops are formed by flowing water in a cave. They consist of a series of small hollows, a few centimetres to a metre across, cut into the walls of a cave by swiftly flowing streams. Their size and shape indicate the speed and direction of the streams. A scallop has a steep slope on its upstream side and a gentle slope on its downstream side. Water flowing very rapidly will form a smaller scallop than will slower moving water. (Moore and Sullivan, 1978)

Boxwork - Boxwork is the result of both the solution and the deposition processes. Small cracks in limestone occasionally become filled with calcite deposits. Later, the more soluble limestone is dissolved, leaving a network of thin calcite flakes protruding from the walls and ceilings of a cave. (Adams and Wyckoff, 1971) (Hill, 1976)

Deposition formations occur when calcite is deposited, one crystal at a time, on the ceilings, walls, and floors of a cave. (Whitfield, 1980)

The most common of these formations is caused by dripping water and is

called dripstone. Dripstone formations include stalactites, stalagmites, and flowstone.

Stalactites - When a drop of water hangs from the ceiling of a cave, it deposits a small ring of calcite before it falls.

This process continues until a long, tubular stalactite, the diameter of a drop of water, is formed on the ceiling. Subsequent drops of water may run down the sides of the stalactite, depositing layers of calcite until the formation becomes massive. However, at the center of every stalactite there is, or once was, a small, hollow tube, the diameter of a drop of water. (Moore and Sullivan, 1978)

Stalagmites - When water drips from a cave ceiling or a stalactite,
the impact of the water striking the floor breaks the
drop of water into many tiny droplets which then have
more surface area than the original drop. Carbon dioxide
is suddenly released from thes surfaces and the water
can no longer hold calcite in solution. (Moore and Sullivan,
1978) The calcite is deposited on the floor and gradually
forms an upright pillar, known as a stalagmite. When
a stalagmite and a stalactite meet, they form a column.
(Montana Department of Fish, Wildlife and Parks, 1983)

Flowstone - Flowstone is caused by water flowing over walls, floors, and other cave features and depositing calcite in layers.

(Montana Department of Fish, Wildlife and Parks, 1983)

This is the process that creates massive stalactites from narrow, tubular ones. (Adams and Wyckoff, 1971)

The formations that fall into the category of flowstone are draperies, bacon strips, and travertine.

Draperies - Draperies are made up of flowstone formed by channelled, flowing water. Where water flows down an inclined surface for a long period of time, it deposits sheets of calcite that sometimes have the appearance of a "frozen waterfall". (Montana Department of Fish, Wildlife and Parks, 1983)

Bacon Strips - Bacon strips are sheets of calcite, about a half a centimetre thick, that hang from the ceilings of caves. They are formed when a single drop of water flows down a slanted surface, leaving a minute trail of calcite. This process is continued until the calcite is several centimetres deep. Impurities in the calcite often color bands in the deposit red or brown, creating the striped appearance of a strip of bacon. (Moore and Sullivan, 1978)

Travertine - Travertine is the term given to banded layers of calcite. (Montana Department of Fish, Wildlife and Parks, 1983) These occur in different colors due to impurities in the cave water. (Adams and Wyckoff, 1971) (Moore and Sullivan, 1978)

The preceding descriptions are of dripstone formations. These are usually the most abundant in the cave environment and are also the most well known. There are other formations, however, equally important to a study of caves. Although a complete list of these features would be very large and somewhat inappropriate to this report, a selection of those that occur in British Columbia is described below.

Helictites - Helictites are small, twisted formations that protrude from ceilings, walls, and other cave formations. They occur when water is emitted from a very small hole and does not form into a drop. Gravity, therefore, does not act on the water. Rather, it is forced out of the hole

by hydrostatic pressure and calcite is deposited in an almost random formation. (Hill, 1976)

- Cave Coral Cave coral consists of slender, branched needles of calcite that grow upward and outward from a cave floor. (Montana Department of Fish, Wildlife and Parks, 1983) It is formed by water seeping through a crack in the cave floor and between the crystals of the coral itself. (Moore and Sullivan, 1978)
- Cave Pearls Cave pearls are rounded calcite formations that range from less than a millimetre to almost fifteen centimetres in diameter. (Moore and Sullivan, 1978) They are formed in pools around a nucleus of sand, rock, or calcite, where the water is sufficiently agitated to prevent adherence to the bottom of the pool. (Montana Department of Fish, Wildlife and Parks, 1983)
  - Clusterite Clusterite is a group of small, rounded knobs that protrude from limestone rock in a cave. It is formed by water sweating out of the pore spaces in the rock.

    (Montana Department of Fish, Wildlife and Parks, 1983)
- Rimstone Dams Rimstone dams grow upward in crescent shaped ridges from the floors of caves and trap water behind them. The process is self perpetuating because aeration of the water trickling over the calcite deposits promotes a loss of carbon dioxide and, therefore, a deposition of more calcite on the dams. (Jennings, 1971)
  - Moonmilk Moonmilk is a soft, putty-like material that forms on the walls of caves. It consists of calcite and bacteria. The presence of bacteria in cave water constitutes a variation in the chemical environment which prevents calcite from developing in its usual solid form. Rather, it occurs as

minute, distinct crystals suspended in micobiological material. (Moore and Sullivan, 1978)

### Wildlife

Cave wildlife can generally be divided into three categories: those that use caves, those that live in caves, and those that live only in caves. (Moore and Sullivan, 1978) Wildlife that use caves to avoid adverse weather conditions or for protection from predators are called trogloxenes. They are occasionally found in caves but never complete their entire life cycle in them. Wildlife that live in caves but are capable of survival in daylight are called troglophiles. They generally live their lives underground while other individuals of the same species live outside. Finally, wildlife that are found only in caves, and are adapted to life without light, are called troglobites. These creatures generally have little or no skin pigmentation and nonexistent or almost sightless eyes. They are not capable of survival outside the cave environment. (Waltham, 1974)

Trogloxenes are common in British Columbia and include many species of insects, some birds, and a variety of mammals, including bats, bears, porcupines, rabbits, etc. (Burt and Grossenheider, 1976) Troglophiles that are known to exist in the province include worms, insects, and some species of opilionids and spiders. Because the cave environment in British Columbia is relatively cold, salamanders, that are often found in warmer cave climates are excluded from local caves. (Behler and King, 1979) Furthermore, there are no known species of mammals or fish that live their entire life cycles in British Columbia's caves. (Burt and Grossenheider, 1976) Known troglobites of British Columbia are not common or diverse. They consist of insects and spiders. (Waltham, 1974)

### Climate

Temperatures inside most caves remain fairly constant throughout the year. Cave air currents are usually so slow that by the time air has penetrated the first few hundred feet of passage, it has reached the same temperature as the limestone walls of the cave. Cave temperature, therefore, is determined by the temperature of the surrounding rock. This is approximately

equal to the mean annual temperature of the air outside. (Moore and Sullivan, 1978) In British Columbia, this temperature ranges from about -1.3 degrees Celcius in Fort Nelson to almost 10 degrees Celcius at the Vancouver Airport. (Schaefer, 1978)

Relative humidity in most caves is 100%. This means that cave air is completely saturated with water. (McClurg, 1973) The constant temperature of the cave environment allows for this condition to be maintained indefinitely. (Moore and Sullivan, 1978)

Air currents inside most caves are generally almost imperceptible. They are usually caused by cave air adjusting to changes in outside air pressure. During the day, outside air is warmed and, therefore, becomes less dense. Cave air then moves out of the cave in response to the decrease in pressure. This process is reversed at night. Another cause of cave air currents is related to seasonal temperature changes and occurs when a cave has an upper and a lower entrance. Because a cave maintains the mean annual temperature of the air outside, cave temperatures are colder in the summer and warmer in the winter than those outside. Therefore, in the winter, air enters a cave's lower entrance, becomes warmer, and rises to emerge from the upper entrance. The reverse of this process occurs in the summer. (Moore and Sullivan, 1978)

### 4.0 USES OF LIMESTONE CAVES

In prehistoric times, Neanderthal and Cro-magnon man used caves as dwellings in what is now Europe and Africa. During this time, however, British Columbia was covered with a thick sheet of ice. (Haviland, 1978) Therefore, there have never been any "cave men" as such in British Columbia's caves. However, evidence suggests that caves have been used as places of ceremony by the province's earliest inhabitants. (British Columbia Ministry of Lands, Parks and Housing, 1980) Today, although tremendous opportunity for scientific research exists, the use of these caves is primarily recreational.

### Conservation

Because of the very slow rate at which cave features form and their extreme sensitivity to impact, conservation is of vital concern in cave use. Several conservation problems and guidelines for responsible caving practices have been identified by the National Speleological Society (United States). These are listed below.

### a) Abundant Evidence of Traffic

Caves are quite often muddy, and footprints can rapidly appear everywhere. This is more than an aesthetic problem. Mud tracked over calcite formations will not only disrupt their growth, but may bury them entirely, making them visually unavailable to subsequent visitors. Also, small or delicate formations may be destroyed by a careless visitor. Appropriate action to avoid this situation is simple. Cave visitors must stay on established trails. If access to a particular route involves the destruction of any cave formation, that route must be considered inaccessible.

### b) Removal of Cave Formations

Cave features are often removed as souvenirs. This is completely unnacceptable. Even if objects taken are those that have already been broken, they are still part of the cave environment. In fact, some cave formations, such as cave pearls, are formed around broken pieces of calcite. The best souvenirs of a cave experience, therefore, are photographs.

#### c) Destruction of Cave Formations

Cave features are often very fragile and should never be touched. Because of the contortions involved in cave exploration, inadvertent breakage of delicate formations can easily occur. A cave visitor must be very careful, therefore, in choosing routes and deciding if further travel on a particular route is possible. Also, navigation must be undertaken in a cautious and deliberate manner to avoid unnecessary stumbling that may be not only dangerous, but damaging to the cave. A further problem with regard to the destruction of cave formations occurs when visitors touch calcite in a cave. The oil in human skin prevents further deposition of calcite on a formation. Calcite formations must never be touched.

### d) Marking of Cave Walls

Cavessare sometimes marked by visitors to designate a particular route. This is a good idea to prevent getting lost in an unfamiliar cave, but should never be done in a permanent manner. Reflective ribbon or arrows that can be later removed are the best way to prevent

disorientation. Other forms of markings on caves include an individual's initials and a date at the end of a particularly difficult passage or obscure chamber and acts of outright vandalism. Both of these situations are completely unacceptable and must be prevented.

### e) Disturbance of Cave Wildlife

Many species of cave wildlife are rare and are sensitive to disturbance. Hibernating bats, for example, if disrupted too often, will deplete their winter store of energy and die before spring. Cave life, therefore, should be left alone. Photographs are, again, the best souvenirs.

### f) Litter

Litter should never be left in caves. It is not only aesthetically unappealing, but, as is the case with spent carbide from carbide lamps, can be toxic to cave organisms and disruptive to the formation of calcite features. Anything taken into a cave should be subsequently removed.

An awareness of conservation is essential to responsible cave exploration. By adhering to the aforementioned guidelines, a recreational caver ensures that the environment that attracted him or her to a cave will exist for other visitors or subsequent visits. Take nothing but photographs and leave no trace of your passing.

(National Speleological Society, 1974)

### Safety

As is the case with any sport, there are hazards specific to caving. However, the use of proper equipment and common sense can minimize the risk involved in cave exploration. Cave hazards that are encountered in British Columbia include:

- Loose rocks or cave-ins
- Vertical drops
- Passageway constrictions
- Underwater passageways
- Flooding

- Disorientation
- Hypothermia
- Rescue difficulties

(British Columbia Ministry of Lands, Parks and Housing, 1980) Although these hazards are potentially very dangerous, precautions can be taken to ensure a safe and enjoyable cave experience.

### a) Leave Information

A caving party should always leave information with someone regarding the destination and duration of a caving trip. This is done so that rescue operations can begin in the event of an accident. It is preferable to overestimate the length of time required in order to prevent unnecessary preparations. However, for the same reason, it is important to actually return at the specified time. (McClurg, 1973)

### b) Size of Party

A caving party should consist of a minimum of three people and a maximum of six. Three people are necessary so that, in the event of an accident, one person can remain with the victim while the other goes for help. More than six people in a caving party becomes confusing and, therefore, potentially dangerous. (Vancouver Island Cave Exploration Group, 1978)

### c) Limitations of Party

It is important that a caving party never excede the limitations of the least experienced member. Also, all cave party members must be aware of their own limitations and must never encourage other individuals to overstep theirs. (National Speleological Society, 1974)

### d) Disorientation

Even for the most experienced caver, getting lost in a cave is possible and temporary disorientation is almost inevitable. Should this situation occur, the best recourse is to remain at the same location and call out at regular intervals. In this manner, a caving party can be quickly reunited. (McClurg, 1973)

#### e) Mineshafts

Mineshafts are usually unsafe and should never be explored by a recreational caver. Caves are formed in solid rock, over millions

of years, and have been subject to earthquakes and similar forces, while mineshafts are, at best, a few hundred years old and are notoriously unstable. (McClurg, 1973)

### f) Hypothermia

Hypothermia is a rapid loss of body heat and is a very real danger in cave exploration. The cave environment is often cold and always wet. Prolonged activity, exhaustion, or a loss of willpower under these conditions can easily result in hypothermia. Proper clothing, not becoming overly fatigued, and a positive mental attitude are the best methods of avoiding this condition. (McClurg, 1973)

### Rescue

Cave rescue can be extremely difficult and is one of the most specialized forms of caving. Long, vertical drops and tortuous or constricted passageways make movement of an accident victim a slow and laborious process. Also, the danger of hypothermia is considerably increased for an injured caver. (Setnicka, 1980) For this reason, specialized techniques and equipment have been developed to quickly and safely remove an accident victim from a cave. These consist of cables, ropes, pulleys, and stretchers adapted for cave use. (McClurg, 1973) In British Columbia, cave rescue operations are generally undertaken by caving organizations which supply this specialized equipment and technical expertise. (British Columbia Ministry of Lands, Parks and Housing, 1981)

### Equipment

Man is completely out of his element in the cave environment. However, with the proper preparation and equipment, danger and discomfort can be minimized and the cave experience can become exciting and enjoyable. The following is essential to any cave visit:

- Three sources of light, including a headlamp, a flashlight, and at least one candle.
- A helmet or hardhat with a chinstrap
- Warm clothes
- Rubber soled boots

(Vancouver Island Cave Exploration Group, 1978) This is the absolute minimum required for safe caving of any duration. Cave visits of an extended nature or under difficult conditions require more specialized equipment which varies with the character of the cave visited. Some of this equipment and its applications are described below:

#### a) Coveralls

Coveralls protect the caver from abrasions better that a shirt and pants because they cannot separate to expose bare skin. Also, they keep mud and dirt away from the skin more effectively than alternative forms of clothing.

### b) Gloves

Gloves guard the caver's hands from sharp rocks and protect cave formations from the oil in human skin.

### c) Pack -

A small, easily removable pack is convenient for carrying extra sources of light, a first aid kit, an emergency blanket, water, rope, and other personal caving equipment.

### d) Climbing Gear

A harness, rope, and carabiners are essential for any vertical cave exploration or when traveling over precipitous drops. Similar to mountain climbers, cavers are belayed with ropes for safety during perilous situations. Other related equipment includes a sling, prusiks, and rappelling and ascending gear. Steel cable ladders are sometimes used instead of rappelling and ascending equipment.

### c) Wet Suit

Wet suits or dry suits are used in caves that contain streams or lakes. They insulate the caver from the cold water and allow for cave exploration of extended duration in very wet caves.

(McClurg, 1973)

#### Techniques

The extreme unevenness of underground passageways, in conjunction with obstacles such as rocks and cave formations, demands that a caver move

in a cautious and deliberate manner. A careless motion could easily result in personal injury or damage to the cave. Therefore, a good sense of balance should be cultivated for underground exploration. Also, because distances are difficult to judge in the cave environment, jumping should be avoided. Furthermore, it is wise to stop moving when examining cave features.

Travel in caves often involves crawling. However, a prolonged use of the knees is not recommended because of the loss of body heat and likelihood of a knee injury. When crawling through very tight places, it is sometimes necessary for a caver to remove his or her helmet and pack. Again, it is unwise to hurry through a constricted passage and deliberate movements are recommended. Also, when crawling in an inclined passage, it is usually best to proceed feet first. Crawling backward uphill is difficult.

In the case of a constricted chimney, it is necessary to straddle the opening and proceed by pressing outward, against the walls, with both hands and feet. This technique is also used in mountain climbing. In fact, most methods of travel in very difficult sections of caves have been adapted from mountain climbing techniques. A very important difference, however, is that cave rock is generally much less solid that mountain rock.

Many caves contain water. When it is sufficiently deep, underwater travel becomes necessary. Underwater cave travel ranges in intensity from a short dive to the next available air space, to prolonged dives with complete scuba gear. Underwater cave exploration is very dangerous and should not be attempted by an amateur caver. (McClurg, 1973) "Most underwater cave rescues are body recoveries." (Setnicka, 1980)

#### WORKS CITED

- Adams, George F. and Wyckoff, Jerome. 1971. Landforms. New York: Golden Press.
- Behler, John L. and King, F. Wayne. 1979. The Audubon Society field guide to North American reptiles and Amphibians. New York: Chanticleer Press.
- British Columbia Ministry of Lands, Parks and Housing. 1981. A statement of crown land cave policy and administration. Victoria: Queen's Printer for British Columbia.

resources of British Columbia: a discussion paper.

- Burt, William H. and Grossenheider, Richard P. 1976. A field guide to the mammals of America north of Mexico. New York: National Audubon Society.
- Haviland, William A. 1978. Anthropology. New York: Holt, Rinehart and Winston.
- Hill, Carol A. 1976. Cave minerals. Huntsville, Alabama: Speleopress.
- Jennings, Joseph N. 1971. Karst. Cambridge, Massachusetts: M.I.T. Press.
- Montana Department of Fish, Wildlife and Parks. 1983. <u>Lewis and Clark</u> Caverns employee's manual. Three Forks, Montana.
- McClurg, David R. 1973. The amateur's guide to caves and caving. Harrisburg, Pennsylvania: Stackpole Books.
- Moore, George W. and Sullivan, G. Nicholas. 1978. Speleology: the study of caves. Teaneck, New Jersey: Zephyrus Press.
- National Speleological Society. 1974. Policy statement and guidelines on cave exploring.
- Schaefer, D.G. 1978. Climate. in <u>The soil landscapes of British Columbia</u>. Victoria: Queen's Printer for British Columbia.
- Setnicka, Tim J. 1980. <u>Wilderness search and rescue</u>. Boston: Apalachian Mountain Club.
- Vancouver Island Cave Exploration Group. 1978. Going caving?
- Waltham, Tony. 1974. Caves. New York: Crown Publishers.
- Whitfield, Phil. 1980. Cody Caves Provincial Park. in Exploring the Southern Selkirks. ed. John Carter and Doug Leighton. Vancouver:

  Douglas and McIntyre: 59 63.
- Zim, Herbert S. and Shaffer, Paul R. 1957. Rocks and minerals. New York: Golden Press.

2000

CAVE MANAGEMENT AND INTERPRETATION

IN BRITISH COLUMBIA

#### 1.0 CAVE MANAGEMENT

Because of the very slow rate at which cave features form and their extreme sensitivity to impact, a comprehensive cave management plan is essential to ensure the quality and future availability of the cave resource in British Columbia. Also, it is important to know exactly what features and hazards exist in a cave in order to develop effective management policies. Finally, once policy statements are determined, development must proceed in accordance with management decisions and must be monitored to evaluate effectiveness. (Ministry of Lands, Parks and Housing, 1981)

### Cave Resource Inventory.

A cave resource inventory involves the identification of all features in a cave and an assessment of their significance. Geological, speleological, biological, and recreational features must all be considered and evaluated in terms of their capability to withstand use and value as a recreational feature. Analysis of this information should provide management direction and indicate an appropriate level of use for a particular cave. (British Columbia Ministry of Forests, 1983)

#### Cave Conservation

Conservation may well be the single most important aspect of cave management. Because of the irreplaceable nature of cave features and the fragility of the cave environment, there are no second chances. Cave management must, therefore, be vitally concerned with vandalism, litter, and overall cave deterioration to ensure the preservation of the cave resource in the province. Vandalism inside a cave consists of blatant vandalism (i.e. J.S. was here) and inadvertent damage such as the marking of cave routes or extraction of cave features for souvenirs. The reasons for these acts must be understood before appropriate management action can be implemented. For example, the act of removing cave features may be a result of a lack of information. Therefore, an appropriate management response may be to increase the amount of information available to cave visitors regarding the reasons for leaving features in a cave.

Another problem associated with cave conservation is the deterioration of a cave due to use. This is an unavoidable situation. However, it can be minimized with proper cave management. Of primary consideration, is the concept of carrying capacity. Every cave has an appropriate level of use, beyond which damage to that cave becomes unacceptable. This use level must be carefully considered and defined in a management plan.

Deterioration of a cave due to use of land adjacent to the cave is another management consideration. Because of the important role of water in cave formation, this problem is primarily related to water quality and quantity. A change in the chemical composition or the suspended load of a stream that enters a cave may result in a severe transformation of the cave environment. Also, the amount of water entering a cave must not be altered by above ground activities that may cause flooding or drought in a cave. (British Columbia Ministry of Lands, Parks and Housing, 1980)

### Management Policies

In British Columbia, caves are either on private land, managed by the owner (usually in conjunction with local caving groups); on crown land, managed by the Ministry of Forests; or on park land, managed by Provincial or National Parks.

Private Land - The input of caving organizations into the management of privately owned, wild caves is generally a positive one because there is no conflict of interest in their objectives.

They exist to encourage the use and understanding of caves and to promote safety and conservation while exploring this resource. (McClurg, 1973)

Crown Land - The Ministry of Forests objective with regard to cave
management is "to manage the recreational and aesthetic
values of caves on crown lands under Forest Service
jurisdiction in conjunction with plans prepared for the

management of other natural resources, particularly timber."
The tool used to achieve this objective is the Modified
New Mexico Cave Inventory and Classification System. This
system consists of a standard format for recording cave
specific information and a technique for cave classification.
Caves are classified by rating them in three areas: resource
values, hazards, and appeal. Based on this information. a
cave falls into one of three management classes for which
the Ministry of Forests has outlined specific guidelines
for use of the cave itself and the land immediately
adjacent to it. (British Columbia Ministry of Forests, 1983)

Parks - Caves that fall into National Parks jurisdiction are currently being approached with extreme caution. Because of National Parks emphasis on conservation, it has a no-access or limited access policy for most of its caves.

Nakimu Cave, for example, in Glacier National Park, is gated to control unauthorized entry.

It is Provincial Parks policy to inventory and classify all caves known to exist on park land and outline priorities regarding all aspects of their use. Although most are inaccessible or gated for conservation or safety reasons, two caves are open to public visitation: Cody Caves near Ainsworth and the Horne Lake Caves on Vancouver Island near Port Alberni. The primary role of these caves is to act as a "vehicle to present and interpret to the public a speleological natural feature and to educate the public in the principles of cave conservation and safe cave exploration." (British Columbia Ministry of Lands, Parks and Housing, 1975) Caves within the Provincial Park system are asigned a primary objective such as interpretation, conservation, or safety and appropriate management priorities are assigned a primary objective such as interpretation, Columbia Ministry of Lands, Parks and Housing, 1980)

### Management Techniques

Techniques used to achieve cave management goals can be as subtle as the wording in an interpretive brochure or as blatant as a locked iron gate. Some of these techniques are identified and descibed below:

### a) Information

The information released about a cave's existence and location can influence the amount and type of use it receives. For example, a cave that is known only to a local caving club will receive use exclusively by that club. This principle can also apply to areas within a cave. By leaving a particularly sensitive area off a cave map, use of that area can be decreased. A problem with this technique is that secrecy never lasts. Even if a few individuals are aware of the location of a cave or a cave route, it will eventually become common knowlege. Also of note is that the way cave information is presented can influence its use. A cave can be made to sound as inviting or as foreboding as the language used to describe it. For example, off site information can present a cave as fascinating, but extremely hazardous, thus promoting vicarious use of the cave.

### b) Access

If access to a cave becomes difficult, the use of that cave will be reduced. Conversely, a well maintained, conspicuous road or trail will promote intensive cave use. Also, access to a cave can be eliminated entirely with a gating system. This may be a viable alternative for very sensitive or dangerous cave environments. Access can also be controlled within a cave. It may be that only particular areas or routes are inappropriate for a high level of visitation. In this case, gating, camouflaging, or otherwise blocking a route may be the best option.

#### c) Development

The level of development of a cave can range from the paved trails, restaurants, and gift shops found in the Mammoth Cave in Kentucky to the wild caves that are most common in British Columbia. Although local caves are not suitable for the scale of development found in some American caves, certain options are available in this area of cave management.

Facilities outside a cave, such as outhouses, picnic tables, and campsites, will attract visitors because of the convenience provided to the recreational caver. Also, the level of development will influence the type of visitor that comes to a cave. An experienced caver may prefer a completely undeveloped cave that is inappropriate to a vacationing family. Similarly, structures inside a cave, such as ladders and catwalks, can affect the intensity and distribution of cave use. (British Columbia Ministry of Forests, 1983)

### d) Monitoring

Some method of monitoring the effectiveness of management techniques is essential to determine whether or not management objectives are being met. Both the level of use and the level of impact must be examined to achieve this goal. A common method of monitoring the level of use a cave receives is the trail register. Although not all visitors use the trail register and, therefore, the figures provided are not necessarily accurate, they will reflect trends. The monitoring of impact is somewhat more difficult. Because damage sustained by caves is often slow and often almost imperceptible, it is difficult to determine when deterioration has reached an unacceptable level. The camera, however, is capable of providing a permanent and definite record of previous conditions. Photo-monitoring of cave resources is a practical and conclusive method of gauging impact. This information, in conjunction with cave use records, can be useful to judge management effectiveness. (Fletcher, 1977)

#### 2.0 CAVE INTERPRETATION

"Interpretation is a means by which facts and understandings are conveyed between someone who is familiar with the subject and others who are not." (Hewston and Wood, 1979) Effective cave interpretation involves not only an understanding of cave features and processes, but also, an awareness of interpretive objectives. Interpretive techniques must be appropriate and compatible with these goals. (Hewston and Wood, 1979)

### Interpretive Objectives

The objectives of cave interpretation are education, conservation, and safety. An emphasis on one or more of these objectives will be dictated by the features, hazards, and appeal of a specific cave. Therefore, although similar messages are applicable to all caves, a primary interpretive goal must be cave specific, and is a management decision. (British Columbia Ministry of Lands, Parks and Housing, 1980)

Education - It is the role of interpretation to provide information in a manner that is both educational and entertaining.

(Lewis, 1981) In a cave situation, cave exploration itself is entertaining. Therefore, this aspect of interpretation is practically taken care of. This is not

to say, however, that information can be given in a dry and lifeless manner, but that, because of the nature of the cave environment, frivolous entertainment may be out of context and may, in fact, be damaging to other interpretive messages, such as conservation or safety.

Information that should be included in an interpretive program includes historical and regional context, features that exist in the cave, and the locations of routes. Identification of features should include the location of the feature and its significance. Route location must also mention the length of the passage and hazards that may be encountered. (Hewston and Wood, 1979)

Conservation - A strong conservation message must be included in all aspects of cave interpretation. This cannot be overemphasized. However, because there are so many activities that cannot be undertaken in a cave for conservation reasons, care must be taken to present these restrictions using positive, rather than negative, diction. A long series of statements beginning with the word "don't" is likely to irritate most cave visitors. Also, it is important to explain the reasons for the restriction of activities rather than simply forbidding them. (Montana Department of Fish, Wildlife and Parks, 1983) The following, however, is a list of forbidden cave activities:

- Breaking or removing cave materials
- Touching cave formations
- Leaving the established route
- Littering
- Disturbing cave wildlife

(Vancouver Island Cave Exploration Group, 1978)

Safety - In order to promote safe cave exploration, visitors should be advised of the equipment necessary for a particular cave. Also, potential hazards, and precautions that can be taken to avoid these hazards, should be identified.

(British Columbia Ministry of Lands, Parks and Housing, 1980)

### Interpretive Techniques

Interpretive techniques used to achieve the objectives outlined for a particular cave include off site techniques, such as slide presentations, brochures, and displays, and on site techniques, such as signs placed at or near the cave and various types of tours. Off site presentations and displays can be developed to present information and visual images that give the recipient a feeling of having experienced all the cave has to offer and, therefore, discourage actual use of the cave. Conversely, they can promote use by offering a sample of the cave experience and providing information about a cave visit. The tone of a brochure can also be chosen either to provide information or to facilitate use.

On site techniques, because they are presented to a visitor at the cave site, are less concerned with influencing use levels. Rather, as is the case with interpretive signs, they tend to be of an informational nature. Signs can be classified as being one of two types: simple signs that provide merely a conservation and safety message, and complex signs that include educational information and, possibly, a map.

By far the most effective interpretive technique is a guided tour. It provides information to the visitor in a personal manner, and conservation and safety messages can be not only presented, but enforced. Another type of tour is the self guided tour. This can be implemented in conjunction with interpretive stations marked in the cave, or with the aid of a brochure. Interpretive stations are probably an unacceptable alternative for most caves because they are somewhat obtrusive and, therefore, detract from the quality of the cave experience. Brochure aided tours, however,

can be very effective because they provide interpretive information in a cave setting without detracting from the aesthetics of the cave. Also, they represent a souvenir that the visitor can take home. (British Columbia Ministry of Lands, Parks and Housing, 1980)

### WORKS CITED

- British Columbia Ministry of Forests. 1983. A method to manage the cave/ karst resource within British Columbia's provincial forests. Burnaby, British Columbia.
- British Columbia Ministry of Lands, Parks and Housing. 1981. A statement of crown land cave policy and administration. Victoria: Queen's Printer for British Columbia.

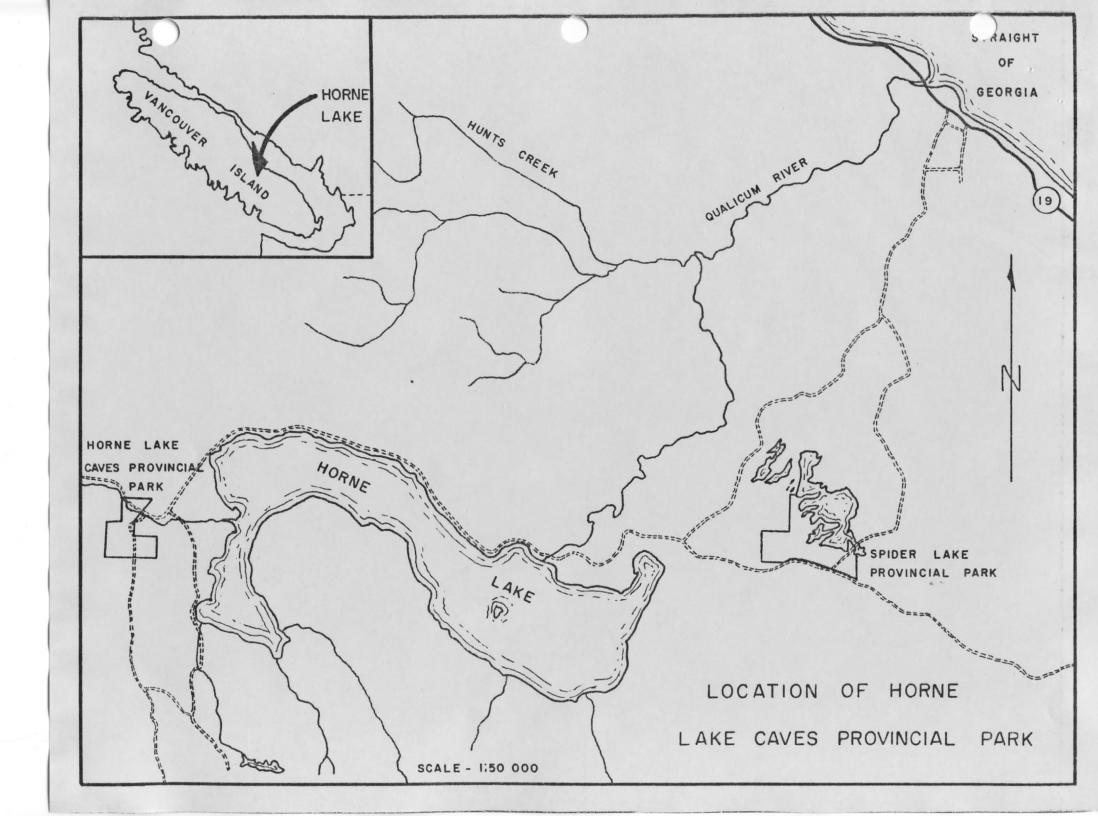
resources in British Columbia: a discussion paper.

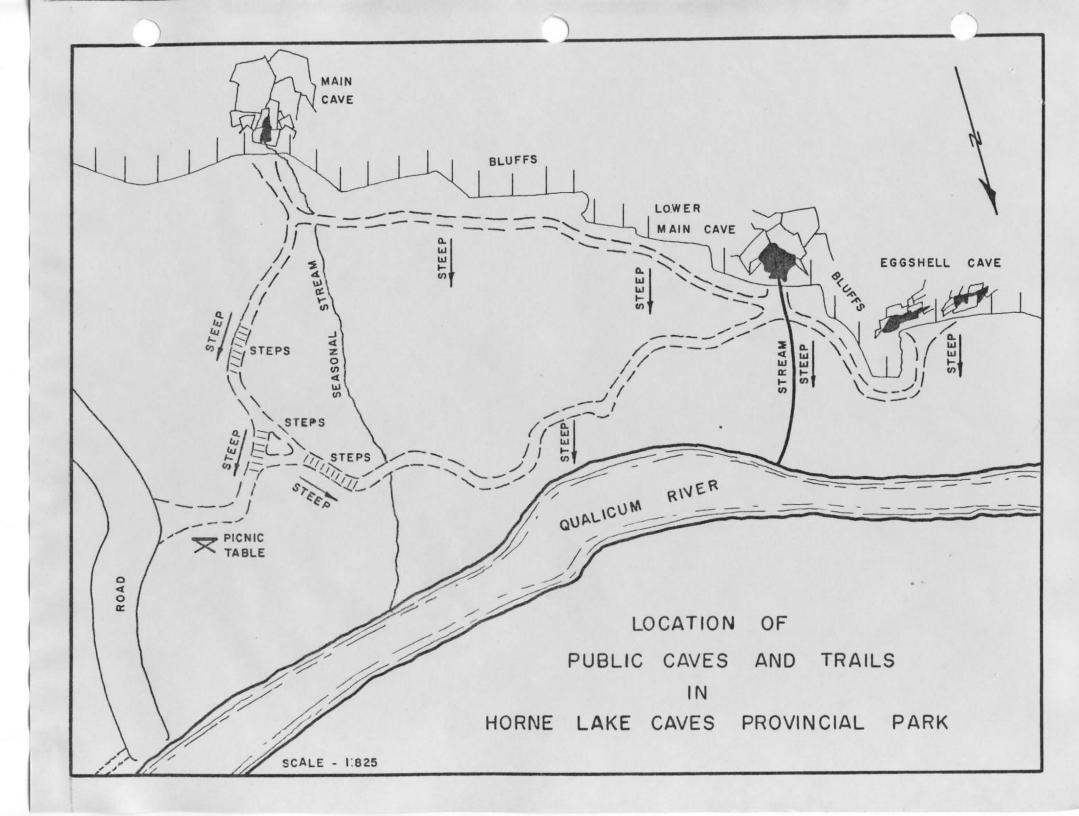
1975. Interim

policy statement for Cody Caves Park.

- Fletcher, Milford. 1977. Photography as a management tool. Unpublished manuscript.
- Hewston, Jody M. and Wood, Edward E. 1979. Objectives, techniques and training for effective cave interpretation. Unpublished manuscript.
- Lewis, William J. 1981. <u>Interpreting for park visitors</u>. Vermont: Eastern Acorn Press.
- Montana Department of Fish, Wildlife and Parks. 1983. Lewis and Clark Caverns employee's manual. Three Forks, Montana.
- McClurg, David R. 1973. The amateur's guide to caves and caving. Harrisburg, Pennsylvania: Stackpole Books.
- Vancouver Island Cave Exploration Group. 1978. Going caving?

THE HORNE LAKE CAVES





#### 1.0 LOCATION AND DESCRIPTION

### Location

The Horne Lake Caves are located in a limestone belt between 145 and 290 metres above sea level in the Beaufort Range of the Vancouver Island Mountains. They can be reached by following a secondary road that leaves the west side of Highway #19 about thirteen kilometres north of Qualicum Beach (see enclosed map). The road is approximately fifteen kilometres long and, although occasionally rutted with potholes, is passable year-round in most vehicles. It passes Spider Lake Provincial Park and the Horne Lake Campground before arriving at a small parking area on the north side of Qualicum River, about one kilometre west of Horne Lake. Across the river, a short loop trail provides access to the three public caves within the system.

#### Description

The Horne Lake system consists of four caves with an overall passage length of greater than sixty metres and several others of smaller size. Of these caves, three are open to public visitation: Horne Lake Main Cave, which contains about 136 metres of explorable passage; Lower Main Cave, around forty metres in length; and Eggshell Cave, which extends less that twenty metres. Two other caves in the system, Riverbend and Euclataws, are not open to the public. Riverbend Cave is considered to be the most hazardous in the park and, for this reason, must be visited with the aid of a guide. Euclataws Cave contains abundant fragile cave features in a relatively undisturbed state and is therefore visted only for scientific research.

The public caves in the park have been all but completely destroyed. Calcite formations that once decorated these

formerly attractive caves have been made almost indistinguishable by the mud and debris that has been tracked into them.

Litter and broken glass can be found in even the most inaccessable passageways and spray paint decorates many of the cave walls. In the three caves open to public visitation not one feature remains intact in any of the accessable chambers or passageways. Euclataws and Riverbend Caves have been gated to protect them from the abuse suffered by the public caves.

### 2.0 HISTORY

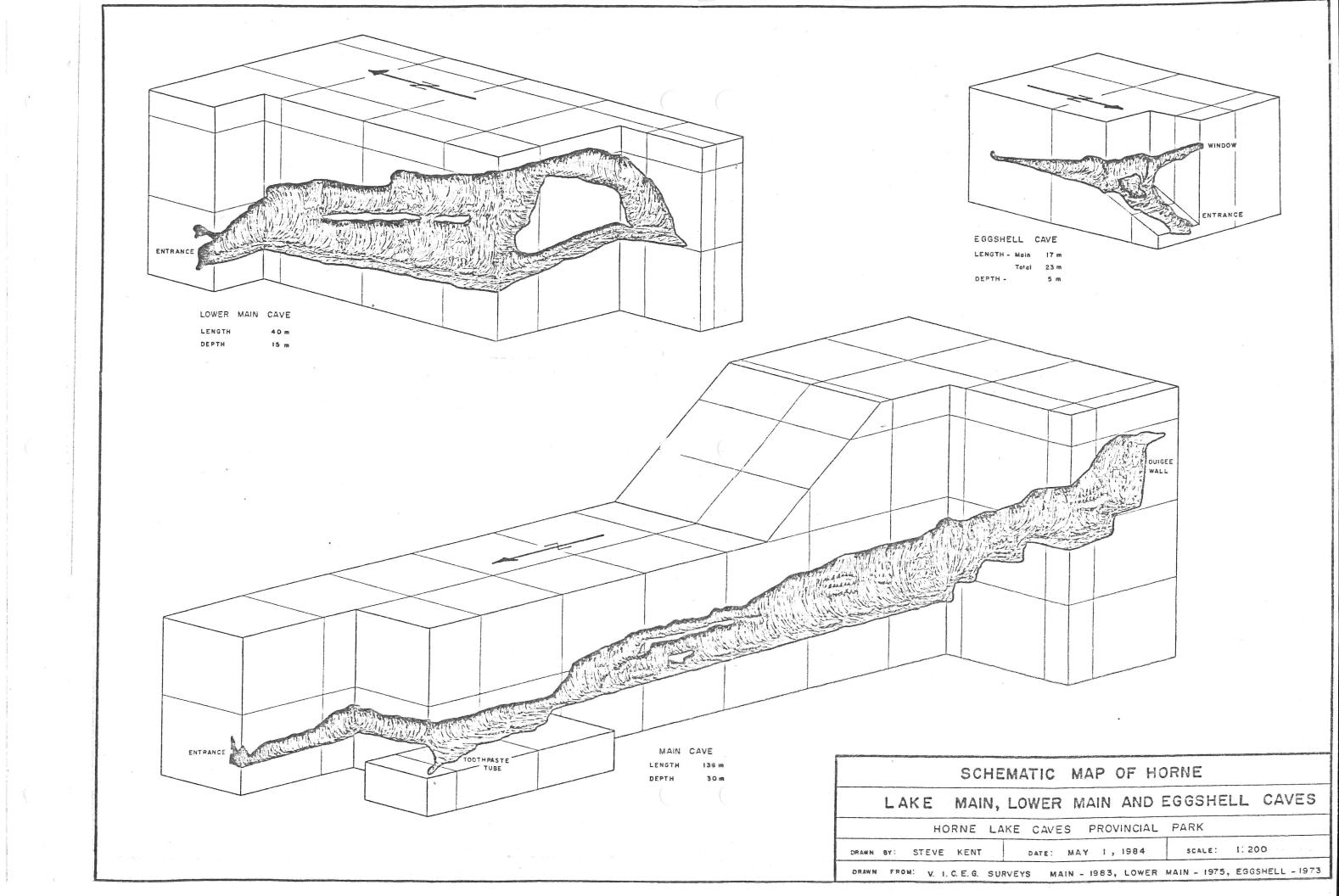
# Geologic History

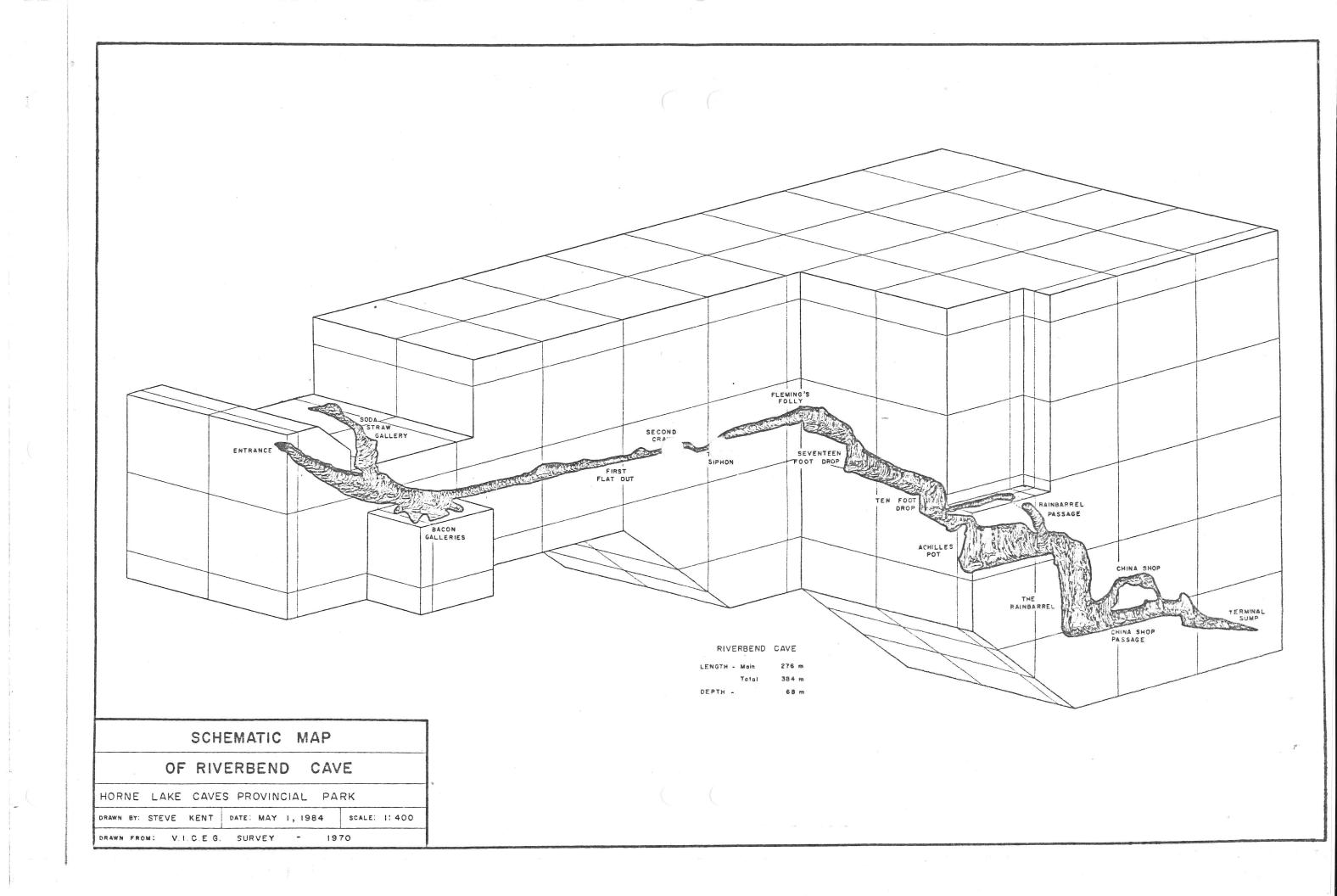
The limestone beds that contain the Horne Lake Caves are of the Buttle Lake Limestone Formations and were formed in the early Permian period of the Paleozoic era, around three hundred million years ago. Subsequent mountain building forces that occurred around 170 million years ago exposed the limestone beds to heat and pressure creating a folded marble limestone and thrusting it to the surface. Surface and subsurface waters then dissolved the exposed limestone and the formation of the Horne Lake Caves began. The majority of the deposits in the caves were extablished between sixty-five and forty-five thousand years ago. (from Northcote, K. E. Limestone of the Horne Lake - Cascade Cave Systems, Vancouver Island)

# Recent History

Local Qualicum Indians were the first people to know of the Horne Lake Caves as they frequently travelled a trail that passed near the entrances. Their exploration of the caves was however, limited because they feared the wild and evil spirits which, no doubt, lurked in the dark passageways. In 1912, a local geologist reported observing limestone caves in the area but did not undertake any serious exploration of these caves. A few years later, timber harvesting operations

opened up the Horne Lake area and local loggers were, no doubt, exposed to the caves. It is not known whether the caves were explored at this time or not. However, during logging operations one of the caves, probably Lower Main, was dammed to provide water for the steam donkeys that were used to skid timber from the forest. In the spring of 1939, the caves were rediscovered by two amateur explorers who brought the "Horne Lake Wonder Caves" to public attention. The caves (Main and Lower Main) were subsequently surveyed by the British Columbia Travel Bureau. They reported finding several hundred feet of well decorated passage, but no evil spirits. Two years later, in 1941, "a regular labyrinth of passages and chambers" was reported by a storekeeper at Qualicum. This amateur explorer claimed to have ventured into a sizable passage for a quarter of a mile until his failing flashlight forced a return to the surface. Mr. Reid pointed out that his cave was not near those previously discovered. From his description of the cave entrance, he probably discovered what is now known as Riverbend Cave. By 1945 the caves were becoming a point of interest for hardier tourists. Also, although there was still evidence of many beautiful formations, most had already been removed by souvenir hunters. In 1957, Main Cave was re-surveyed by two provincial government employees and a 71 acre piece of land around the caves was set aside by Order-in-Council and established as a Recreation Reserve. This area was then known as Horne Lake Caves Park. The discovery of Euclataws Cave, in 1968, (the cave was actually found by a husband and wife team from Nanaimo in 1964 who kept its existance and location a secret) resulted in much pressure from local cave enthusiasts to protect the area from further vandalism and abuse. By February, 1971, the area was established as a class "A" Provincial Park making it one of two cave parks in British Columbia. The second is Cody Caves Provincial Park, located in the West Kootenays near Ainsworth. (from Griffiths, Paul. 1975. Horne Lake Wonder Caves)





#### 3.0 FEATURES

### Main Cave

The entrance to Main Cave consists of a tall, narrow crack in the limestone that has opened up along vertical joint planes in the rock. This crack forms a passage into the inner chambers of the cave. The largest series of chambers in the cave run north to south and are slanted steeply (50°) to the west. In these chambers, evidence of the cave's former beauty is still apparent but its present condition is apalling. Vandals and careless visitors have left the larger calate formations covered with mud and littered with broken glass and other debris. All easily removed features in the cave have long since disappeared. Near the rear of the cave a small stream cascades down a series of small drops and disappears into a sump in the floor. This stream is actively eroding and disolving the limestone of the cave to create a narrow vadose canyon that runs from the sump upwards to the source of the stream water. At the top of the canyon, water dripping from the cave ceiling, sometimes in large quantities, runs down a wall of flowstone almost seven metres in height and forms the stream that runs through the rear chambers of the cave. The constant flow of water over this calcite wall has kept it relatively free of mud but litter and broken glass are evident even in these remote areas of the cave. Animal life in the form of harvestmen (Daddy Long-legs) and crickets can be seen on the walls and roof of the cave. Mould growth and seed germination occur very quickly in the cave. However, as soon as the nutrient source in used up, the mould or seed immediately dies. Photosynthesis is impossible in caves.

### Lower Main Cave

Lower Main Cave is much smaller than Main Cave but is in similar condition. Many stumps of what must have been spectacular formations can be seen but the most common feature of the cave is, again, litter and graffitti. The most obvious natural feature of Lower Main Cave is a fairly substantial stream that flows the length of the cave and emerges at the entrance. Also of note is that the ceiling is over twelve metres high in some sections of the cave. As is the case with Main Cave, harvestmen and crickets are relatively common in these chambers.

# Eggshell Cave

Eggshell Cave is very small and has a steep, narrow entrance. It contains one oval gallery that is two metres in diameter and just large enough to stand up in. From this chamber a small window can be seen above and to the left of the entrance. The rear of the cave consists of a short, narrow passage that quickly becomes too small to travel in. It was named for the hollow-sounding floor that is the result of a thin layer of calcite deposited over mud. Harvestmen are abundant in this cave.

### Cougar Cave

Cougar Cave is located on the trail to Riverbend Cave. It consists of a hole in the ground about one metre in diameter that drops steeply (60°) approximately twelve metres into a small chamber littered with animal bones. It is thought that a cougar once inhabited this cave and returned to eat its prey. There are no calcite features in the cave.

### Riverbend Cave

Riverbend Cave can be visited only with the accompaniment of a qualified guide. In spite of a few break-ins and acts of vandalism, the most recent of these occuring in November of 1983, the cave remains relatively intact. For this reason, and the fact that a complete exploration requires technical equipment and expertise, the cave has been gated to protect not only the quality of the cave features, but for the safety

of the public as well. The entrance of the cave is developed along a steeply dipping bedding plane that levels out near two very well decorated chambers known as the Soda Straw Gallery and the Bacon Gallery. A small stream enters the cave near this point. The passage descends to the north with a gradually decreasing slope. Approximately eighty metres from the entrance the first of two winding "flat out crawls" are encountered. Thses are followed by a siphon that makes access behond this point impossible during periods of high water. After the siphon, the cavern developes into a winding series of narrow vertical drops of five, three, and fifteen metres respectively. These lead to a gallery known as the China Shop where spectacular formations are abundant. Ten metres past this chamber the cavern ends with water flowing into a terminal sump. (from Copland, Hugh J. April, 1982. Geology and Genisis of Limestone Caverns at Horne Lake Provincial Park.)

#### WORKS CITED

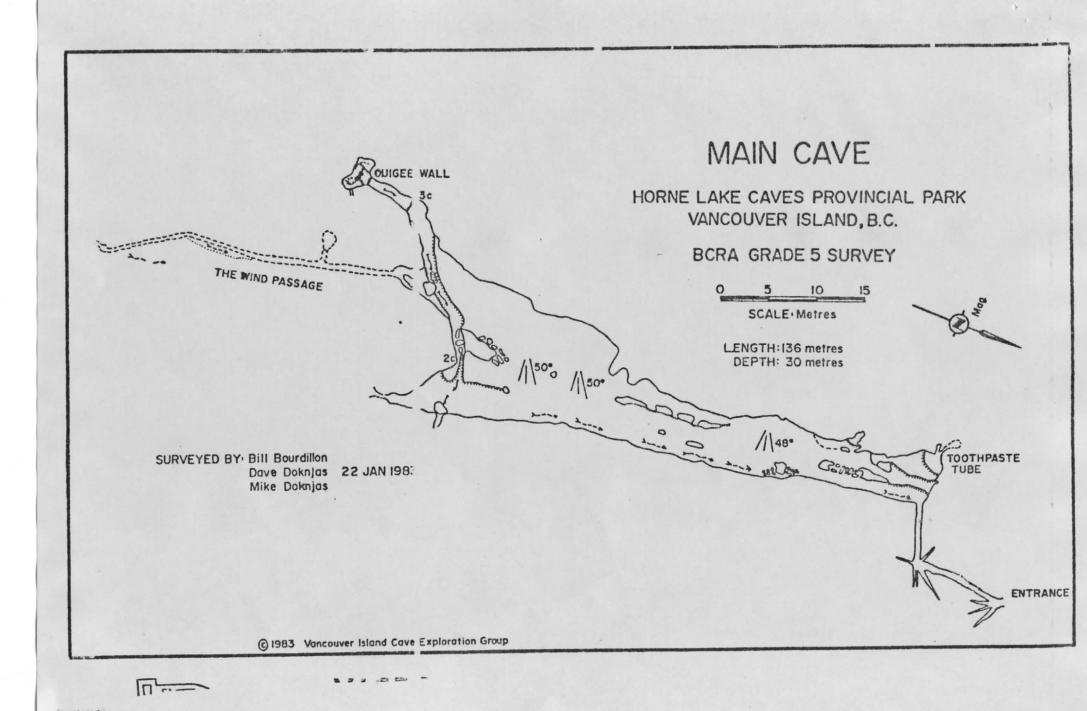
- Copland, Hugh J. 1982. Geology and Genisis of Limestone

  Caverns at Horne Lake Provincial Park. U. B. C.

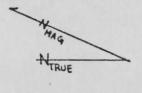
  Thesis, Department of Geology, Faculty of Science.
- Griffiths, Paul. 1975. Horne Lake Wonder Caves. Gold River: Maquinna Publishing.
- Northcote, K. E. <u>Limestone of the Horne Lake Cascade Cave</u>

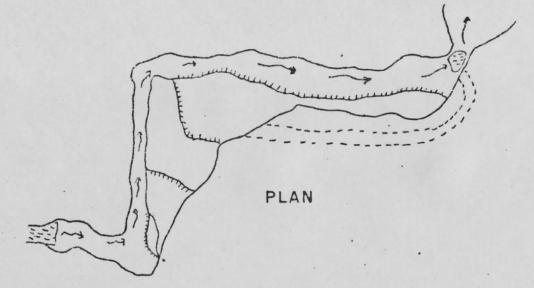
  <u>System, Vancouver Island.</u> V.I.C.E.G. Geological

  Note #2.

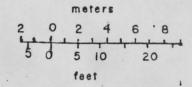


HORNE LAKE, VANCOUVER IS. CRG GRADE 4 13:10:73





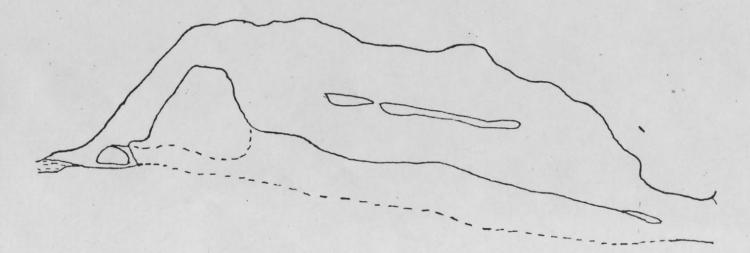
LENGTH: 40.5 m. (133 ft.) DEPTH: 14.6 m. (48 ft.)



POINT: R.COLES R.POULTON

COMPASS: L.VAN EK NOTES: L.TUTTLE

EXTENDED PROFILE



# EGGSHELL CAVE

HORNE LAKE

C.R.G. GRADE 4 SURVEY

1-9-1973

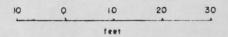
COMPASS: L. VAN EK NOTES: L. TUTTLE POINT: E. HAMILTON D. CORNISH DRAWING: L. TUTTLE

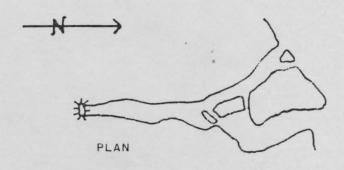
E. WHITFIELD

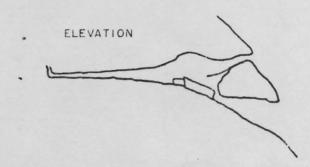
LENGTH, MAIN: 55.0 FT.

TOTAL: 74.0 FT.

DEPTH: 18.0 FT.



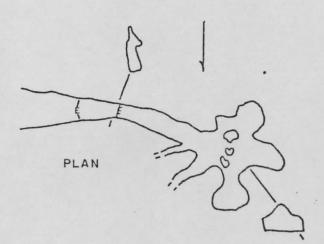




# COUGAR CAVE

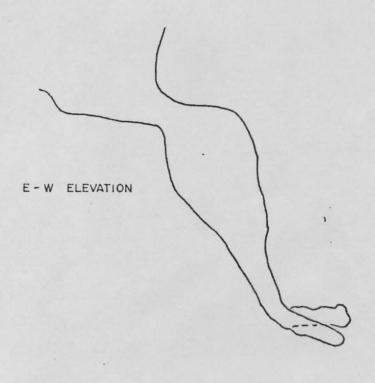
HORNE LAKE

13-10-73 CRG GRADE 4



LENGTH: 29.0 m.

DEPTH: 14.2 m.



### SURVEYED BY:

DUANE CORNISH
ERNIE HAMILTON
PHIL WHITFIELD

2 0 2 4 6 8 meters

O Vancouver Island Cave Exploration Group

