PALAEONTOLOGICAL AND ARCHAEOLOGICAL CAVE RESOURCES IN BRITISH COLUMBIA: A DISCUSSION OF MANAGEMENT ISSUES

- Carol L. Ramsey

The following discussion paper is intended as a companion piece to another document, Best Management Practices for Palaeontological and Archaeological Cave Resources (aka 'The Palaeo Policy'). Some years back, largely because of his involvement in palaeontological research activities at K1 Cave (described below), Paul Griffiths saw a need for a set of best practice guidelines for this type of research in British Columbia (BC) Caves. His first and second drafts were circulated to a number of local and international colleagues, land managers, and archaeologists; their suggestions and feedback have been incorporated. More revisions and ideas came from discussions with colleagues at the 2003 ACKMA conference.

In the spring of 2003, Paul asked me if I would like to undertake revisions for Draft 3. Naturally, I was delighted to do so. One of the comments received from the circulation of Draft 2 noted that an explanation of various types of cave values might be helpful. This discussion paper below grew out of that suggestion. Though the issues raised will be familiar to most ACKMA members, I wrote under the assumption that my primary target audience (i.e., various BC land managers, stakeholders, archaeologists, and palaeontologists, etc.) would have no previous knowledge of cave/karst management issues. Both documents are works in progress and will probably continue to evolve in response to feedback. The version of the discussion paper has been somewhat abbreviated for publication here.

My intent with the discussion paper was to show why a cave-specific Palaeo Policy is needed in BC. My hope is that this paper, together with the third draft of the Palaeo Policy, will raise local awareness of some of the management issues surrounding research activities in BC caves.

INTRODUCTION

Cavers the world over have long been aware that bone assemblages are a relatively common component of the underground landscape. British Columbia (BC) cavers have occasionally brought bone samples to researchers for scientific analyses (e.g., Nagorsen *et al.* 1995). In recent years, however, limestone solution caves in this province have become the focus of more intense scientific research. Academics have begun to venture underground in BC in search of palaeontological assemblages which have the potential to provide new information for late Pleistocene/early Holocene environmental reconstructions and biogeography.

An encounter with an articulated deer skeleton in a Vancouver Island Cave

As early as 1984, Roemer (1984:61) wrote about the potential significance of palaeontological material in a Vancouver Island cave:

If, as suspected, the skeletons prove to be of considerable age, they would constitute a unique record of the species combination for the time …

In the 1990's, some researchers in BC undertook small-scale studies of palaeontological specimens recovered from caves. Nagorsen *et al.* (1995) examined and described a small assemblage of early Holocene black bear bones recovered from Vancouver Island's Windy Link Cave and in conjunction with pollen and charcoal recovered from the same site, made inferences about past environmental conditions in the area. Faunal remains recovered from other Vancouver Island caves were analysed and described by Nagorsen *et al.* (1996). These assemblages included marmot bones which exhibited signs of butchering. In addition to their archaeological significance, the assemblages also provide evidence that the Vancouver Island marmot, now an endangered species, was once more plentiful and occupied a much greater range. Other small assemblages of faunal material from other Vancouver Island caves, including mountain goat bones (an animal not found on the island today) are described by Nagorsen and Keddie (2000).

The real "BC Cave Bone Rush", however, did not really get under way until after 2000. Following the work of Tim Heaton and his colleagues in caves on Prince of Wales Island Alaska (e.g. Heaton *et al.* 1996), Canadian researchers began to utilize the full potential of solution caves as sources of faunal material which could shed additional light on regional palaeo-environmental conditions along the

BC coast. Work at K1 cave, Queen Charlotte Islands (Haida Gwaii – see endnote), has produced black bear bones dating to 14 400 radiocarbon years B.P. (Ramsey *et al.* 2004), as well as fragments of projectile points which may constitute some of the earliest known artifacts on the west coast (D. Fedje, pers. comm.). This work is important in terms of its implications for early human migration routes and the region's glacial history (see Text Box 1, below). In a similar vein, research by Ward and his colleagues (Ward *et al.* 2003) at a cave site on the west coast of Vancouver Island has brought to light a faunal assemblage dating to the pre-glacial maximum.

What distinguishes these most recent research activities in BC caves is the sheer scale of the operations. While the earlier studies focused on small scale collecting of surface-scattered bones, these more recent projects have involved researchers and their crews entering caves to conduct reconnaissance missions in search of palaeontological and/or archaeological material and to undertake subsurface excavations. Concerns about the potential impacts these activities may have on BC caves, and the fairly intense media coverage these studies have received have served as the impetus for both this paper and its companion document.

The moist acidic soils of the northwest coast of BC tend not to preserve bone well; by contrast, karst caves tend to supply a suite of conditions uniquely conducive to bone preservation – protection from weathering, and stable conditions, including the higher pH of cave substrates, constant, relatively cool temperatures, and constant high humidity (Baichtal *et al.* 1996; Schulte and Crocker-Bedford 1998). As the IUCN World Commission on Protected Areas publication *Guidelines for Cave and Karst Protection* (1997:7) observes, "Caves often contain important archaeological and palaeontological material which is well preserved only in this environment".

Caves often provide ideal conditions
for bone preservation.

Given this ability to preserve archaeological/palaeontological materials, it is likely that interest in palaeontological/archaeological research in BC caves will continue to intensify. However, while the examples given above illustrate the potential scientific value of palaeontological and archaeological cave deposits, these are not the only set of values associated with caves. Readers unfamiliar with cave and karst management issues may not be aware of the scope of these values and thus may not understand why ecologically-based and holistically-oriented stewardship of caves is required. The first objective of this paper is to acquaint the reader with the full spectrum of cave values.

Some of the very characteristics which make caves so amenable to the preservation of bone or archaeological material also render caves much more vulnerable than surface sites to anthropogenic disturbances. Many people are unaware of how easily caves (or the values they contain) are damaged or degraded by human visitors. A second objective of the paper is therefore to highlight how cave values can be negatively-impacted by human activities, including those of well-intentioned researchers.

The overarching goals of this paper are twofold: a) to ensure that adequate consideration is given to designing and conducting research in a manner consistent with the needs of each cave, and that impacts that might result from such activities are minimized; b) to provide a set of best practices guidelines for proposed research activities in BC caves.

In this paper I suggest that British Columbia's *Heritage Conservation Act* (HCA) is poorly designed to protect the full spectrum of values associated with palaeontologically- or archaeologically-significant caves. Though the HCA appears to be generally broad enough in its intent to cover the full range of cave values, it does not, in practical terms offer automatic protection to any cave resources other than archaeological material (unfortunately, palaeontological material seems to fall into a bit of a grey area at present, perhaps reflecting an inherent anthropological bias in the Act). Moreover, the HCA currently does not adequately protect caves and karst from potential degradation resulting from permitted archaeological research activities. Other, non-archaeological research activities that might take place in caves are simply not addressed. I argue here that caves constitute a special case, meriting special protective measures not currently provided for under the HCA and that in particular, a revised system of permitting is urgently needed. To this end, I endorse the adoption of the best practice guidelines outlined in the companion document, *Best Management Practices for Palaeontological and Archaeological Cave Resources, Draft 3*, in order to provide a higher level of protection for caves containing palaeontological and archaeological materials.

CAVE VALUES

As noted above, the range of cave values often surprises those unfamiliar with cave and karst management issues. Publications such as the IUCN's (World Conservation Union's) *Guidelines for*

Cave and Karst Protection (1997), The Cradle of Humankind World Heritage Site's *The Management of Karst Landscapes and Caves* (Buchanan and Maguire 2002), the New Zealand Department of Conservation's (NZ DOC) *Karst Management Guidelines: Policies and Actions* (1999), J. N. Jennings' *Karst* (1973), and Kevin Kiernan's *The Management of Soluble Rock Landscapes: An Australian Perspective* (1988) not only provide excellent introductions to the broad spectrum of cave and karst values, but also highlight international recognition of the need for proactive, holistically-oriented management for karst and cave resources. The BC Ministry of Forests publications *Karst in British Columbia: A Complex Landscape Sculpted by Water* (1997), Stokes and Griffiths' *A Preliminary Discussion of Karst Inventory Systems and Procedures (KISP) for British Columbia* (2000), the Resources Inventory Standards Committee's *Karst Inventory Standards and Vulnerability Assessment Procedures for British Columbia* (2003), and the *Karst Management Handbook for British Columbia* (2003) provide more locally-based overviews of karst and cave values. The following list, while not exhaustive, includes the cave values most consistently recognized by international and local authorities:

1. Biological Values:

The habitats afforded by caves can be more varied than one might suspect at first glance. Fine gradations of light, temperature and humidity occur as one progresses from the entrance of a cave to the zone of total darkness within.

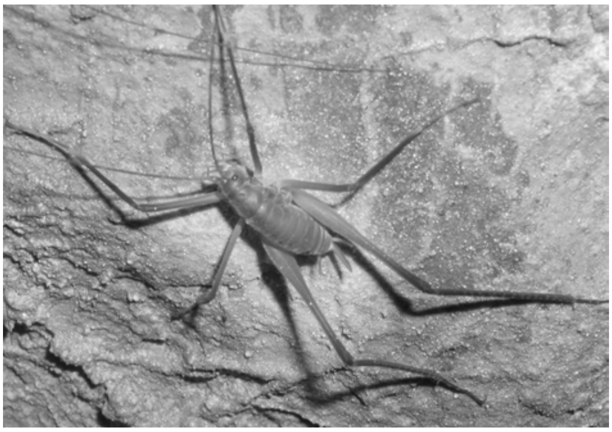
Cave entrances often provide distinctive microclimates coupled with lower levels of light intensity and calcareous substrates. These conditions can result in suites of entrance flora not found elsewhere in the broader landscape. Schulte and Crocker-Bedford (1998) suggest there is some likelihood that relictual populations of plants have persisted around cave entrances. Some animals, such as cervids, have been observed to favor cave entrance zones as bedding sites. It has been suggested that the relative coolness of these zones in summer and their relative warmth in winter, are being used by these animals in a thermoregulatory capacity. (Baichtal *et al.* 1996; Shulte and Crocker-Bedford 1998; BCMOF 1997).

Some animals use caves for various purposes at different times. For example, bats often use caves as hibernaculae and nurseries, while birds and other mammals may nest, den, or hibernate in caves (Baichtal *et al.* 1996; Shulte and Crocker-Bedford 1998; BCMOF 1997). Adult salmon have been observed migrating through a cave on northern Vancouver Island (P. Griffiths, pers. comm.) and spawning in cave systems in southeast Alaska (Baichtal *et al.* 1996).

Cave interior environments possess a number of distinctive characteristics. The most obvious of these is a near or complete absence of light. Relative humidity levels tend to be high, with stable temperatures hovering within a few degrees of the annual mean year round. In these environments photosynthesis cannot occur, so organic debris must be carried into the cave by water, air, gravity, or animals to form the base of the food web (Kiernan 1988; Schulte and Crocker-Bedford 1998). A variety of organisms have successfully adapted to these conditions; Schulte and Crocker-Bedford (1998:17) note that "each of the five kingdoms of life has many representatives in Southeast Alaska caves, including some rare and unusual creatures". Biospeleologists place organisms associated with caves in three categories:

- **Troglobites**: Organisms adapted to life exclusively in zones of total darkness.
- **Troglophiles**: Organisms adapted to life in zones of total darkness, but which can also survive on the surface.
- **Trogloxenes**: Organisms adapted to life on the surface, but which may visit or utilize caves for part of their life cycle.

According to Ulrich (2002:41), "Cave fauna should be a high priority for preservation because their unique characteristics of diversity and ability to coexist in an environment poor in energy resources".



Cave crickets are an example of
troglophiles observed in BC caves

Pielou (1992:162) observes that "Troglobites are common in caves in regions that have been free of ice throughout the present glacial age, but they are extremely scarce in formerly glaciated regions". Populations of cave-dwelling organisms are relatively isolated, and so the potential for rapid speciation exists (Keirnan 1988). For these reasons, studies focusing on the organisms currently inhabiting caves have the potential to identify species new to science, and may contribute as much to our understanding of the region's glacial history and biogeography as the study of bones of long-dead creatures (Schulte and Crocker-Bedford 1998).

The IUCN (1997:13) notes that
Caves and karst are among the most vulnerable of ecosystems, and are often subject to degradation as a result of phenomena or events which occur at a considerable distance. Their effective protection and management therefore requires consideration and action at both area and local levels.

2. Geological Values:

The geological values of caves are myriad and range in scale from the atomic level (e.g., mineral composition) to the level of broad landscape geomorphology. Caves are perhaps the best known type of solutional features associated with karst landscapes. Clues to the types of depositional environments are contained in the host limestone bedrock characteristics. The bedrock may also contain micro- or macrofossils dating to the time when the rocks were formed. Interpretation of rocky relief features within caves can offer insights into speleogenesis, solutional processes, and palaeohydrology (Ford and Williams 1996).

Scallops, a common type of rocky relief feature, are visible in the upper portion of this photo

Many karst caves house a variety of secondary mineral deposits. Speleothems, comprised of calcium carbonate, can take many forms, the best known being stalactites and stalagmites. The type, degree of development, condition, and distribution of speleothems in caves can provide clues about changes in cave climate and hydrology through time. Speleothems can be dated and, through isotopic analyses, can be sources of information about regional palaeoclimates. In addition to speleothems, caves are also known to provide conditions suitable for the development of rare minerals. (Kiernan 1988; Buchanan and Maguire 2002; NZ DOC 1999).

Cave sediments are often described as palimpsests and are considered to be notoriously difficult to interpret by conventional geoarchaeological means (Dincauze 2000), yet they have the potential to provide a substantial amount of information about past environments as new techniques become available.

3. Climatological Values:

Michie (2002:63) states that "the climate of the cave is one of the values that must be managed". The truth of this statement has been perhaps most graphically illustrated by events following the public opening of Lascaux Cave in France in 1948. Michie further notes that the environment of a particular cave is influenced by its shape. Since caves do not conform to standard shapes, sizes, and configurations, each cave's climate is unique to some extent. Troglobites, which may be relictual or disjunct populations, have presumably adapted to unique climatic conditions peculiar to the caves they have evolved in. It is not always known what impacts fluctuations in CO2, temperature, and humidity resulting from extended human activities might have on the cave's ecology.

Light and noise are factors surface dwellers take for granted, yet these may be considered disturbances in the underground environment (Kiernan 1988). The effects of light and noise on invertebrate troglobite, troglophile, and trogloxene populations have apparently not been extensively studied to date, though some researchers have begun to address this issue (e.g., Merritt and Baker 2002).

4. Hydrological Values:

Hydrologically-active solution caves can be an important subsurface drainage component of karst systems. Such systems often have the capacity to transport large volumes of water underground for many kilometers much faster than non-karst groundwater aquifers. Karst hydrological systems are not necessarily influenced by a landscape's surface topography, so substances such as contaminants or dyes introduced into a karst sink point in one topographically-defined watershed can reappear in a completely different distant watershed in a relatively short period of time. Thus, the effects of disturbances in karst hydrological systems are not necessarily localized, but can be readily and quickly transferred to other seemingly unrelated parts of the landscape (BCMOF 2003).

It has been found that aquatic karst ecosystems on the northwest coast of North America tend to be more productive for fisheries than those flowing through or across non-soluble bedrock (Baichtal *et al.* 1996). Several factors contributing to this higher productivity have been identified by Alaskan researchers. These include

a) the raising of pH values as calcium carbonate is leached into streams;

b) the tendency of karst streams to supply more nutrients utilized by aquatic plants;

c) the capacity of karst systems to moderate seasonal fluctuations in water temperature (Baichtal *et al.* 1996; BCMOF 2003).

As was pointed out earlier, troglobites are sustained largely by organic material carried into the cave from the outside; water flowing through caves provides an important means of transport.

The NZ DOC (1999:8) points out that

"Subterranean karst and cave hydrological systems" are included in an international conservation classification of types of wetland (Contracting Parties to the Convention on Wetlands 1998).

5. Archaeological/Palaeontological Values:

Some northwest coast examples were discussed earlier in the introduction. Appreciation of the palaeontological/archaeological values in caves along the northwest coast of North America has greatly increased in recent years; in other parts of the world, these values have long been recognized (some famous international examples are given in Ford and Williams 1996, Keirnan 1988, and Buchanan and Maguire 2002). Some of the world's most important palaeoanthropological sites are associated with caves. In addition to their importance as a source of hominid fossils the South African cave sites serve as modern analogues for past geological processes:

… "modern" dolomitic caves … provide a living example of the processes of sedimentation (cave filling), consolidation, calcification, decalcification, collapse and erosion. Such processes were also responsible for producing the famous fossil sites, which represent the erosional remnants of former ancient cavern systems and their contents (Buchanan and Maguire 2002:5).

6. Recreational Values:

Show caves and recreational caving opportunities are probably more readily available and well known elsewhere in the world than they are in Canada. Nonetheless, many BC caves (and we have quite a few!) are still in relatively pristine condition and this, coupled with often spectacular wilderness settings, contributes to their attraction as recreational sites. A BCMOF publication (2003:11) states that

The globally significant karst areas of British Columbia attract recreationists and caving enthusiasts from around the world . . . Each year, increasing numbers of people visit British Columbia's provincial forests, parks, and recreation areas for self-guided or commercially guided karst and cave experiences.

In recent years, hot air ballooning expeditions have been undertaken in caves in the USA and France.

7. Cultural/Traditional Values:

Human uses of caves have been surprisingly varied through time and across cultures. Their use as habitations and places of interment by some cultures is familiar to most people. Less familiar examples include the use of caves as sanatoria/respiratory therapy clinics (Jennings 1973; Kiernan 1988), garbage dumps, refuges, and proposed nuclear fallout shelters (Jennings 1973). Jennings (1973:227) notes that caves can

also provide cheap storage – in peace as with Roquefort cheese in the Causses of France and in war as with Nazi petrol and oil reserves in Postojna Cave in Slovenia until partisans coming by unguarded distant entrances set fire to the military dumps.

Cave discotheques are found in such countries as France, China, and Cuba.

8. Aesthetic/Spiritual Values:

Ironically, aesthetic values are often tacked on last, as a sort of after-thought meriting only token mention in the hierarchy of cave values. This is unfortunate, since the scenery afforded by many caves, both above- and below-ground, can be spectacular:

Probably the primary recreation and tourist use is simply to be there to take in and appreciate the often striking karst surface landscapes . . . people also visit caves each year, appreciating their awe-inspiring vaults and caverns and regarding the stalactites and stalagmites and other rock formations … with a sense of wonder and delight (NZ DOC 2002:9).

Given that caves are inherently mysterious, and sometimes awe-inspiring, it's not surprising that humans have frequently identified and/or utilized them as spiritual or religious sites across cultures and through time (for specific examples, see Buchanan and Maguire 2002, NZ DOC 2002, and IUCN 1997).

CAVE INVENTORIES AND ASSESSMENTS

The basic aim of a cave inventory is to investigate and document all the values of a particular cave; in this respect it is perhaps analogous to heritage inspections as defined by the HCA (HCA 2003:1:1). Once conducted, a cave inventory can be used as the basis for determining a cave's significance and developing a management plan, and – if warranted – a monitoring program. Detailed inventories can also provide a valuable snapshot of baseline conditions in caves, against which subsequent degradation of cave values may be measured. Speleologists, and indeed, many recreational cavers, often do at least cursory inventories in conjunction with mapping, and for many caves, such inventories suffice. In caves with exceptional values, a more multidisciplinary approach would ideally be required in order to assess cave values adequately:

Since the significance of the subterranean environment covers archaeology, palaeontology, groundwater ecology, microbiology, atmospheric physics, geohydrology, education, tourism, climatology, sedimentology, cave geology and cave ecology, representatives from all of these disciplines would need to serve on the Karst Management structure (Buchanan and Maguire 2002:5).

In general, caves should be evaluated on a case-by-case basis in terms of:

a) the significance of each category of values and

b) the vulnerability of the cave (or portions thereof) to disturbance.

The degree of significance for each of the value categories listed above can vary from cave to cave. One might, for example, have high recreational and hydrological values, but demonstrate low biological, archaeological, and geological values, while another might be significant only in terms of archaeology and aesthetics.

Delegates to the 2003 ACKMA Conference discuss management issues during a field visit to an Australian show cave.

As Kiernan (1988: 41) points out

. . there is a need for cave managers to recognize that each cave has a limiting factor on usage (i.e., the value most at risk). Each site needs to be managed on the basis of the particular limiting factor for that site.

The limiting factor for some caves may well be biological, mineralogical, or any of the other values described above. Management authorities need to establish what that limiting factor is, prior to making any decisions about a cave's use, either by researchers or the general public. The reason for this is that every visit to a cave entails some degree of impact on cave values. The following discussion will address some of the impacts that could result from human activities in caves – including the activities of HCA permit holders.

POTENTIAL IMPACTS

In the earlier discussion, categories of cave values were created for the sake on convenience. In reality, this partitioning is somewhat artificial, for a number of values – cave biology, climate, hydrology, etc. - often represent interactive components of a dynamic system. Any impact to one component is likely to affect the others to some extent. With respect to impacts involving the broader karst landscape (and by extension, their subterranean components), the IUCN (1997:13) notes

The integrity of any karst system depends on an interactive relationship between land, water, and air. Any interference with this relationship is likely to have undesirable impacts, and should be subjected to thorough environmental assessment.

In fact, most karst management guidelines advocate a total catchment management approach.
This paper is concerned with more localized, smaller scale disturbances such as might result from research activities in caves - activities which nonetheless can have significant cumulative negative effects on cave values. The IUCN (1997:12) provides a succinct list of potential impacts which may result from human activities on this scale:

- *alteration of the physical structure of the cave*
- *alteration of water chemistry*
- *alteration of cave hydrology*
- *alteration of air currents and micro-climate*
- *introduction of artificial light*
- *compaction or liquefaction of floors*
- *erosion or disturbance to cave sediments or their contents*
- *destruction of speleothems*
- *destruction of fauna*
- *introduction of alien organisms or materials (e.g., concrete, climbing aids), pollutants, nutrients, animal species, algae & fungi*
- *surface impacts, e.g., erosion, siltation, vegetation change*

The degree to which each of these potential impacts will be of concern with respect to a particular cave will depend on its particular suite of values (as discussed above), their relative significance (*i.e.,* their degree of "specialness", uniqueness, or rarity), and their vulnerability. Impact assessment can be greatly facilitated by referring to cave inventories. Inventories should be carried out in advance of research activities with the potential to cause disturbances in caves.

Each of the impacts listed above will not necessarily be of concern in every cave, or even in all parts of a single cave system. The reason for this is that not all cave segments are equally vulnerable to disturbances. *Karst Management Guidelines: Policies and Actions* (NZ DOC 1999:10-11) provides a clear explanation of why this is so. It is well worth reproducing here the document's energy level rating system for assessing potential visitor impacts:

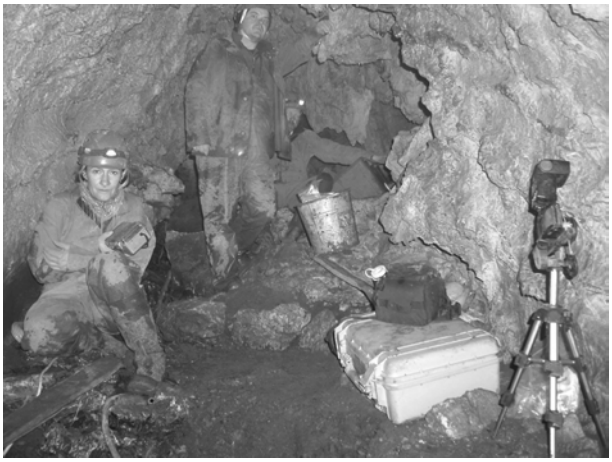
High energy passages are those prone to high energy events, such as flooding, on a regular basis, causing such caves and passages to be regularly modified by rock falls or flooding. Speleothem formation is rare because any that may form are quickly scoured away or broken off. The effects of visitors will generally be minimal.

In moderate-energy cave passages, forces such as running water, persistent wind, or animal activities operate at a lower order of magnitude. These caves often contain the most abundant speleothem formations, reflecting abundant saturated water, although the conditions are too active for the finer growth of crystals (Tercafs 1993). The effects of visitors may be more evident over a period than in high energy caves, although they may be masked by occasional flooding and sediment rearrangement.

In low-energy cave passages, a major event may be a falling droplet of water. Speleothems in a low-energy cave are characterized by small and delicate formations resulting from the minute amount of crystal growth. The presence of visitors in a low energy cave may have a serious effect on the cave environment, as the amount of energy released by them in even a short visit may be more than the cave has experienced in hundreds of years.

In most cases, individual caves are likely to contain components of all three different types of energy level.

Many caves are moderate- or low-energy environments, with essentially little input of energy on a human timescale. The entry of a single caver will change the energy regime…affecting slightly the heat, light, and nutrients there . . . The effects of visitors are generally cumulative, possibly synergistic (i.e., the total is more than the sum of the individual components).



An archaeological/palaeontological excavation site in a moderate-energy passage in K1 cave, British Columbia

Significant undisturbed palaeontological/archaeological assemblages are less likely to occur in high-energy caves or cave passages, since regular flooding or rock falls are liable to redistribute or cover them. Such assemblages are far more likely to be found in moderate- or low-energy passages. The same stable environmental conditions which would tend to facilitate the preservation of palaeontological assemblages and their contexts are those which are most vulnerable to disturbances. Excavations in such passages may entail significant changes to the energy regime, with corresponding impacts to the underground environment. In contrast to disturbances to aboveground sites, traces or effects of human activities in moderate- or low-energy underground environments may persist for hundreds, or even thousands, of years – consider, for example, that what is believed to be a Cro Magnon footprint was discovered on the surface of a sediment deposit in Chauvet Cave, France (Tattersall and Schwartz 2001).

Palaeontological and archaeological field activities within and around caves inevitably entail potential disturbances to cave ecosystems. Given that some cave organisms have adapted to relatively stable conditions in lower energy caves, it is important to consider what kinds of impacts human activities might have on such populations. Common sense and such information as is currently available suggest that consideration needs to be given to the potential impacts of these disturbances and that a cautious, conservative, specialized approach to work in and around caves is warranted.

HOW ADEQUATELY DOES THE HCA SERVE TO PROTECT CAVES?

The BC Heritage Conservation Act (HCA 2003:1:1) clearly recognizes in its definition of "heritage values" that various sites or objects may have aesthetic, educational, scientific, historical, and cultural qualities worth protecting. Most of the cave values discussed above could be interpreted as falling within these parameters. It should then follow that the HCA, whose stated purpose is ostensibly to protect heritage values or heritage sites in this province (HCA 2003:1:2) should suffice to address and protect all cave values. But in practice, does it actually achieve this?

While the HCA's apparent intent is to encompass a broad range of heritage values, there does appear to be an administrative bias in terms of its practical application where caves are concerned – specifically, its permitting policy. At present, the only relevant permitting agency under the HCA appears to the Archaeological Branch, and there are no special provisions for proposed archaeological research in caves.

In caves which possess multiple significant values, archaeological permits can be issued without the requirements of:

a.) prior cave inventories;
b.) cave impact assessments;
c.) cave monitoring during field work (where warranted);
d.) cave remediation (where warranted and *where possible!*)

This current permit system appears to be at direct variance with the HCA's stated mandate to protect a broad range of heritage values, not to mention internationally-recognized principles of cave and karst protection and conservation. What it does do, in practice, is allow researchers with little or no knowledge or experience in cave and karst management and conservation issues to extract archaeological or palaeontological resources which happen to be located within caves in virtually any manner they see fit. Such researchers are not held accountable for any damages or impacts to other cave values that may result from their activities.

The HCA appears to be geared toward protecting heritage sites/heritage values from degradation caused by the general public. This is certainly a valid point, but, where the protection and conservation of some caves is concerned it should be acknowledged that the activities of *bona fide* HCA permit holders can be equally or even more destructive. Most cave managers accept that casual visitors' transient passages through a cave will result in some impacts. Most cave management guidelines (e.g., NZ DOC 1999; IUCN 1997) agree that such impacts are cumulative and perhaps synergistic in nature.

Recreational cavers following good caving practices will make significant attempts to minimize the traces they leave. These attempts may include such strategies as avoiding or minimizing trips through sensitive low energy passages and avoiding disturbing sediments or tracking on flowstone. Researchers who are inexperienced cave visitors can cause as much damage as casual visitors while transiting a cave. As for scientific sampling and excavations underground, the very nature of the work entails relatively large scale disturbance and redistribution of sediments; the introduction of lights and noise for relatively prolonged periods; multiple trips along the same paths, and so on. Indeed, these are disturbances that are almost industrial in scale. Results of the photo monitoring at K1 cave, for example, have already documented some degradation in the form of destruction of entrance flora, speleothem breakage, and soiling of flowstone resulting from research activities covered by a HCA permit. Buchanan and Maguire (2002:19), under the heading "Scientists and Sampling: the need for a revised system of permitting", note that

Until recently, scientists have had a very cavalier attitude towards taking samples from caves, and there is recent evidence of intrusive behavior on the part of scientists. Information yield is not a satisfactory excuse for unnecessarily destructive sampling procedures.

Archaeologists are sometimes called upon to conduct impact assessments in surface contexts; they are not accustomed to, and may be uncomfortable with, the notion that their underground research activities may be detrimental to the cave environments in which they work. However, this is precisely the approach they need to adopt when they venture underground with the intent to conduct scientific sampling or excavations. This is not to imply that scientists, including archaeologists and palaeontologists, willfully set out to damage caves. Most simply have little or no training or experience working in caves, and thus may be unaware of the potential impacts their activities can have on these underground environments.

The majority of these researchers are neither familiar with, nor bound by, caving codes of conduct, nor are they necessarily able to assess hazards or conservation issues in caves. Their training and interests may be highly specialized and confined only to their respective fields. Moreover, many are under tremendous pressure to generate a steady flow of interesting publications – a fact which could potentially compromise their ability to make decisions which are best for caves with multiple values. If the researchers happen not to be of an altruistic or ethical bent, even archaeological/palaeontological values can be potentially compromised by the research activities:

Scientific work itself can be a threat to the long-term value of archaeological resources in karst areas if poorly managed. Once a site is excavated part of the resource is permanently lost to later workers who are likely to bring with them new tools for the assessment, analysis and interpretation of the archaeological record. If an excavation is conducted but the results are not reported the research is valueless and the worker achieves no more than a destructive vandal with much less lofty goals (Kiernan 1988:35).

Given the HCA's mandate to protect a broad range of resources, it should be incumbent upon HCA permit holders working in caves to do the same. A sentiment I have heard expressed by some academics during the course of researching this paper can be summed up as, "Cavers damage caves anyway; at least we're doing it in the name of science!". While it's true that every visit to a cave entails some impacts, and that not all cave visitors consistently adhere to the highest standards of caving conduct, I don't believe this justifies accepting the lowest common denominator as a provincial standard for research activities in caves. Surely a better approach would be for researchers to adopt the highest possible standards geared to minimizing the potential impacts of fieldwork in caves, thus setting an example for others (including cavers!) to follow.

Archaeologists and palaeontologists *must* play an active role in evaluating archaeological and palaeontological material in caves. The value of their expertise and research is not disputed here nor is the HCA's intention to protect archaeological and palaeontological material wherever it occurs. As well, it is acknowledged that the HCA's policy of determining traditional use values of sites by First Nations is completely consistent with the principle of holistic cave assessments. In terms of its practical implementation, however, the HCA appears to effectively protect only a narrow set of cave values, and currently authorizes persons that may be completely unfamiliar with the underground environment to carry out research activities which can potentially degrade other cave values.

Sound cave management practices are firmly rooted in the principles of ecology and the overall needs of cave system ecology should be paramount where conservation of these unique sites is concerned. As the IUCN (1997) document notes, cave ecosystems in particular are vulnerable to disturbance. Though the unique flora and fauna associated with caves could (some would say *should*) be interpreted as a Heritage Value under the HCA's own definition, in practice the Act seems especially poorly designed to address and protect biological values.

It's not clear whether in practice the HCA affords any protection at all to caves hosting significant other values (which could be interpreted as heritage values under the HCA's own definition) but *lacking* archeological or palaeontological material. At present, for example, commercial tours are currently being conducted through highly sensitive BC caves that cannot sustain this level of activity. Because these caves are not known to contain palaeontological or archaeological materials they are not automatic candidates for legal protection under the HCA.

Another point which is not entirely clear concerns how archaeological or palaeontological sites in caves are to be delineated. K1, for example, contains at least one kilometer of passages. Does the term "site" encompass the whole cave, or merely those parts containing archaeologically- or palaeontologically-significant sediments? Or indeed, as would be consistent with karst management guidelines, does the HCA accept the total catchment approach? Who makes this determination?

Measuring pH levels downstream
of K1 cave, British Columbia

Once again: does the HCA serve to adequately protect caves? For the reasons outlined above, I believe that it does not currently provide adequate or consistent protection to caves, and that some aspects of it may in fact be detrimental to caves. The *intent* of the HCA is without question broad enough to address the full spectrum of cave values and is definitely applicable to archaeological and perhaps even palaeontological resources in caves. However, specific, separate, and overarching cave protection legislation should be promulgated to ensure the adequate protection for caves, including those which do not contain significant palaeontological or archaeological material. The BC Cave Protection Act (draft) (Griffiths 1988) is an example of proposed legislation which includes permitting provisions that recognize the complete range of cave values. However, since cave protection legislation has not yet been passed, the following document, *Best Management Practices for Palaeontological and Archaeological Cave Resources, Draft 3*, has been developed to fill the need for a set of interim recommended best practices guide for research activities in caves. Previous drafts of this document have been circulated to cave and karst management specialists in North America and Australasia, selected resource agency personnel in BC, cavers, archaeologists and palaeontologists in BC, the Yukon, Alberta, Quebec, and the USA. The resulting comments and feedback have been incorporated into the current draft.

As stated in the introduction, the intent of this paper is to facilitate palaeontological/archaeological research in caves in a manner that takes into account the full complement of cave values and minimizes negative impacts. An important ancillary goal, however, is to draw attention to the need for more objective and cooperative multidisciplinary cave management and protection in BC Our caves and the values they contain constitute a finite and fragile resource. They deserve a much higher level of protection than they are currently receiving.

ENDNOTE:

Haida Gwaii, the traditional indigenous name for this archipelago, is generally used by more recent researchers in academic journals, as has been requested by the Haida Nation. Normally, I would follow this convention as well, but because some of my intended audience resides in Australasia and other parts of the world, it may cause some confusion without an explanatory note. Earlier researchers tended to use the gazetted name, so readers will find both names interspersed in this paper.

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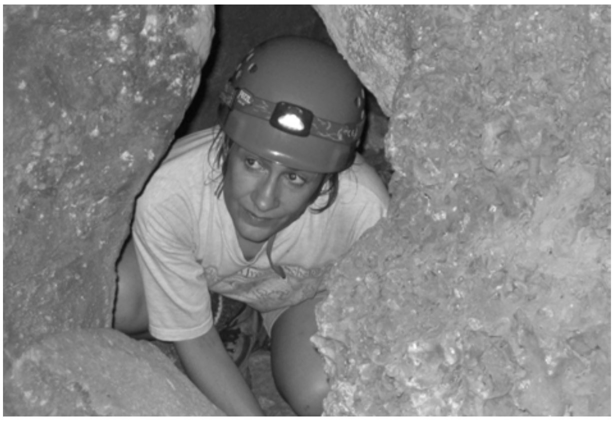

ACKMA member Carol Ramsey received her BA in Anthropology (with distinction) from the University of Victoria in 2001. She was that year's recipient of UVic's Jubilee Medal in the Social Sciences category. Her formal studies focused on the fields of environmental archaeology, taphonomy, and primate behaviour and ecology. Carol has been an important team member involved in the fieldwork at K1 Cave (Haida Gwaii/Queen Charlotte Islands) since the original expedition in 2000. In addition to her working knowledge on a number of important karst sites on Haida Gwaii/QCI, she has visited karst and caves in Australia, Cuba, the Yukon, NW British Columbia, and Vancouver Island. Carol has participated on a number of karst field assessment projects on Vancouver Island and has had considerable experience conducting karst inventories.

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REFERENCES:

Baichtal, J.F., Swanston, D.N., Archie, A.F. 1996. An ecologically-based approach to karst and cave resource management. In: *1995 National Cave Management Symposium Proceedings*. G. Thomas Rea, ed. Pp. 10-27. Indianapolis: Indiana Karst Conservancy publication.

British Columbia Ministry of Forests (BCMOF). 1997. *Karst in British Columbia: A Complex Landscape Sculpted by Water* (Brochure). Forest Practices Branch, Victoria, British Columbia.

British Columbia Ministry of Forests (BCMOF). 2003. *Karst Management Handbook for British Columbia.* Victoria, BC: BC Ministry of Forests.

Buchanan, M., Maguire, J. 2002. Cradle of Humankind World Heritage Site: the management of karst landscapes and caves, final report. Pretoria, South Africa: The Department of Agriculture, Conservation, Environment and Land Affairs.

Ford, D., Williams, Paul. 1996. *Karst Geomorphology and Hydrology*. London: Chapman and Hall.

Griffiths, P. A. 1989. A cave law for British Columbia? The British Columbia Cave Protection Act (Draft). *The BC Caver* 3(2):16-18.

Heaton, T. H., Talbot, S. L., Sheilds, G.F.. 1996. An Ice Age Refugium for large mammals in the Alexander Archipelago, southeastern Alaska. *Quaternary Research* 46:186-192.

IUCN The World Conservation Union. 1997. *Guidelines for Cave and Karst Protection.* Gland, Switzerland, and Cambridge, U.K.

Jennings, J. N. 1973. *Karst.* Cambridge: MIT Press.

Kiernan, Kevin. 1988. *The Management of Soluble Rock Landscapes*. Sydney, Australia: Speleological Research Council publication.

Merritt, D. J., Baker, C. Australian glow-worms. In *Cave Management in Australia: Proceedings of the Fourteenth Australasian Conference on Cave and Karst Management*, ed. K. Henderson, D. Vavryn, and J. Vavryn, 117-119. Victoria, Australia: ACKMA publication.

Michie, N. A. 2002. Radical reduction of cave impacts. In *Cave Management in Australia: Proceedings of the Fourteenth Australasian Conference on Cave and Karst Management*, ed. K. Henderson, D. Vavryn, and J. Vavryn, 62-64. Victoria, Australia: ACKMA publication.

Nagorsen, D. W., Keddie, G., Hebda, R. 1995. Early Holocene black bears, *Ursus americanus*, from Vancouver Island. *Canadian Field-Naturalist* 109(1):11-18.

Nagorsen, D.W., Keddie, G., Luszcz, T. 1996. Vancouver Island marmot bones from subalpine caves: archaeological and biological significance. *British Columbia Ministry of Environment, Lands and Parks, British Columbia Parks Occasional Paper* 4:1-56.

Nagorsen, David W., Keddie, G. 2000. Late Pleistocene mountain goats (*Oreamnos americanus*) from Vancouver Island: biogeographic implications. *Journal of Mammalogy* 81(3):666-675.

NZDOC New Zealand Department of Conservation. 1999. Karst management guidelines: policies and procedures. Wellington, NZ: Department of Conservation.

Pielou, E. C. 1992. *After the Ice Age: The Return of Life to Glaciated North America.* Chicago: University of Chicago.

Ramsey, C. L., Griffiths, P. A., Fedje, D. W., Wigen, R. J., Mackie, Q. X. 2004. Preliminary investigation of a late Wisconsinan fauna from K1 cave, Queen Charlotte Islands (Haida Gwaii), Canada. *Quaternary Research* (in press).

Resources Inventory Standards Committee (RISC). 2003. *Karst Inventory Standards and Vulnerability Assessment Procedures for British Columbia.* Victoria, BC (http://srmwww.gov.bc.ca/risc/pubs/earthsci/karst/index.htm)

Roemer, H.L. 1984. White Ridge as an ecological reserve? *Canadian Caver* 16(2):60-61.

Schulte, P., Crocker-Bedford, K. 1998. *Karst and Caves of Southeast Alaska: a Teacher's Resource.* Ketchikan: UAS Ketchikan and Cultural Heritage Research publication.

Stokes, T., R., and Griffiths, P. 2000. A preliminary discussion of karst inventory systems and principles (KISP) for British Columbia (Working Paper 51/2000) Victoria, BC: B.C Ministry of Forests Research Branch.

Tattersall, I. and Schwartz, J. 2001. *Extinct Humans.* Oxford: Westview Press.

Ulrich, P. B. 2002. Land use in karst terrain: review of impacts of primary activities on temperate karst ecosystems. *Science for Conservation 198.* New Zealand Department of Conservation publication.

Ward, BC, Wilson, M. C., Nagorsen, D. W., Nelson, D. E., Driver, J. C., Wigen, R. J. 2003. Port Eliza Cave: North American west coast interstadial environment and implications for human migration. *Quaternary Science Reviews* 22: 1383-1388.