THE CONSERVATION OF HAWAII'S CAVE RESOURCES

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ABSTRACT

Hawaiian caves have long been known to have significant cultural and archaeological values. Several discoveries during the last decade have revealed important values in biology, geology, and paleontology. More recently, the recreational and aesthetic values of caves have been recognized, especially among national and international caving groups. These seven major values of Hawaiian caves represent a relatively rich resource which is matched by few cave areas elsewhere within the U.S. Unfortunately, conflicts arise among the various groups who are trying to preserve or exploit these resources. In the past, the few visitors to Hawaii's caves belonged to four categories: persons following traditional culture, scientists for research, local youths for sport, and occasional tourists. Vandalism was a critical problem locally and was limited to pot hunters and a few insensitive or destructive persons. The major impacts on cave resources resulted from surface alterations, especially from construction activities, deforestation, and waste dumping. However, with the advent of organized sport caving, particularly by nonresident visitors, the carrying capacity of the caves will soon be surpassed. These sport cavers may appreciate pretty formations and exercise some restraint, but many cultural, paleontological, archaeological, and biological resources will suffer drastically. The imminency of these threats is exacerbated by the recent widespread publicity of Hawaiian lava tubes for their sporting potential in popular journals and documentary films. A more active cave management policy is urgently needed. These policies must reflect the degree of control possible. We can draw upon the experience of cave managers and users elsewhere who have already had to face this dilemma and have developed management policies. However, several unique attributes of Hawaiian lava tubes are particularly vulnerable and require special management solutions.

Caves are defined as naturally occurring subterranean voids in rock which are generally large enough to allow humans to enter. The most common caves in the Hawaiian Islands are lava tubes, but there are also many sea caves and a few limestone caves. Hawaiian caves are a lot more than just holes in the ground. In fact they are of considerable scientific interest. Polynesians from early times used caves for shelter, habitation, food storage, water catchment reservoirs, and crypts. For native Hawaiians, these caves still have considerable cultural value. Archaeologists have long recognized that these caves hold a wealth of knowledge on the culture of precontact Hawaii (Emory et al. 1969; Bonk 1969).

About a decade ago, other scientific disciplines "discovered" many additional values in these caves. In 1971 while working on the International Biological Program, one of us (FGH) somewhat serendiptiously discovered the first cave-adapted animals in Hawaii (Howarth 1972). The on-going biological survey has shown the fauna to be not only diverse but also highly significant for understanding island biology (Howarth 1981). These animals evolved from representatives of native Hawaiian groups by a process of adaptive shifts much as other organisms have evolved to exploit novel habitats. However, the adaptations displayed by these cave animals are truly remarkable, for they present such anomalies as underground tree crickets, blind planthoppers, a terrestrial water treader, and the epitome of adaptive shifts the no-eyed big-eyed hunting spider.

Also in 1971, a new volcanic vent, Mauna Ulu, began to erupt in earnest, and for the first time modern geologists had a front row seat during the formation of a shield volcano. They quickly realized that lava tubes, which form by the crusting over and subsequent drainage of pahoehoe lava channels, play an important role in the formation of volcanic shields by insulating the flowing lava and acting as efficient transport ducts for carrying the pahoehoe lava great distances from the vent (Peterson & Swanson 1974). This discovery catapulted lava tubes from mere geologic curiosities to valuable scientific resources.

Again in 1971, Joan Aidem discovered the bird fossils on Molokai, and although not in a cave, this discovery piqued other cave researchers to watch for bones. Hawaiian caves are now recognized as holding many significant deposits, recording Hawaii's past pheonomenal birdlife (Olson & Wetmore 1976) and possibly even a new bat species.

Up to now the principal threats to Hawaiian cave resources have been the indirect impacts resulting from changing land use practices, such as clearing forest land; construction of buildings, roads and the like; and using entrances as refuse dumps. We cannot save all caves from destruction by these actions, but through workable management schemes, the more significant caves may survive without undue limits on economic gains resulting from land use alterations. In order to accomplish this land managers need to be kept informed of the cave resources under their care, and agencies and organizations concerned with environmental conservation and wise land use strategies must also be aware of potential cave resources. For example, many cave entrances on Hawaii Island have been illegally bulldozed shut and effectively sealed by well-meaning but misinformed construction workers who were unaware of the rich cultural and other cave resources thus destroyed.

Recently however, a new direct impact on Hawaiian cave resources is resulting from the publicity afforded the scientific discoveries. The recreational, explorational, and aesthetic values of caves are now also being recognized. Therein lies a rub, for serious conflicts often develop among the diverse groups that use caves. Unfortunately, it is the caves' resources that suffer most in the wake of these conflicts. Many of these resources are unique and irreplacable. Once gone, we cannot ask a Polynesian fellow to go back in and repair the damage any more than we can direct extinct birds and cave animals to re-evolve, or remelt the lava to again see and study lava dribblet spires.

Caves share with other discrete habitats, such as montane bogs and sand dunes, a vulnerability to trampling and physical disturbance. However, scientists studying surface habitats often need go only 100-200 m away from a well worn trail

in order to lay out their study plots in a relatively undisturbed site. On the other hand, since caves are discrete voids in rock, the cave scientist is restricted to the same passages as every other visitor. Unless he has control over access, he can count on his study areas being crawled through, trampled, or even vandalized. Because of their discreteness, caves have a much lower carrying capacity than do most surface environments.

In spite of the difficulties in locating potentially good caves and enlisting experienced field assistants, we were fortunate to have begun the biological survey in Hawaii before organized sport caving developed here. Our field data on cave animal distribution show that, other factors being equal, species diversity and population levels is inversely proportional to the level of visitation and human disturbance. For example, immatures of both the cixiid planthopper and the cave moth feed solely on living roots that penetrate the cave roof. If the roots are bumped or damaged, many nymphs fall to the floor. In passages where the roots do not reach the floor, dislodged nymphs may not find suitable roots, and they starve. Stepping on roots that do reach the floor may kill their distal portions thereby starving the nymphs feeding on them. As a result the populations of these two species and their predators often reflect the level of human disturbance. Furthermore, hazardous refuse, such as carbide and batteries, left in caves by visitors is detrimental to cave life. Tobacco smoke contains a powerful insecticide which challenges, if not kills, many invertebrates in the relatively enclosed cave atmosphere. In addition smoke from torches and cigarettes further jeopardizes many terrestrial species (Howarth, in press).

Since history often repeats itself, we can study the development of cave conservation in other areas of the world for possible solutions to these problems. Cave exploration as a sport began in earnest in the last century in Europe and to some extent also in America. The sport has been mushrooming in popularity in the last few decades as a result of increased leisure, breakthroughs in caving techniques, and increasing ease of travel. Caves in other regions have experienced a similar scenario of increasing use and abuse by humans. Five stages can be recognized: (1) local use, (2) discovery, (3) recreational caving escalates, (4) resource destruction becomes critical, and (5) cave protection begins in order to preserve what little remains.

As caving pressures increase, the problems encountered are: vandalism, carelessness, accidental breakage, trampling, and pollution which all lead to irreversible damage to the biological, geological, archaeological, paleontological, and aesthetic resources (Stitt, 1977). In addition, land managers have closed caves to researchers as a consequence of increasing conflicts with exploration parties. Many other cave areas have entered the last stage with very few of their cave resources left to preserve. In England, for example, Britton (1976) lamented "In the entire country, no cave now exists which has a man-sized entrance and undisturbed biology or paleontological sediments." In the United States the National Speleological Society (1982) has an excellent but voluntary conservation policy which includes the recommendation that cave locations not be published unless there is adequate protection from vandalism.

Hawaii has been fortunate to have escaped this process until very recently. Caving pressure in Hawaii is now in the discovery phase, with recreational use increasing dramatically. However, this will soon escalate to the next stage in which recreational use exceeds the carrying capacity. Several caving expeditions from North America and Europe to Hawaii are planned within the next year. The

popular accounts of these trips will generage even more visits (e.g. see Wood 1980; Waltham and Wood, 1981). Even though these groups represent responsible experienced cavers they are not likely to be sensitive to local resources and management problems. If we are to save a significant portion of our cave resources we must develop a workable cave management policy as soon as possible.

Recreational caving is not necessarily bad and can be of service in exploring and cataloging caves. Exploration groups sometimes make important initial discoveries. We are sport cavers ourselves and can appreciate the dilemma. However, it only takes a few irresponsible wrecks to destroy cave resources. In addition many caves have very low carrying capacities, especially where significant resources are located so that they cannot escape disturbance by exploration parties.

How do we raise the sensitivity of cavers to recognize cave resources and conserve them? Caves are, in many ways, another world often requiring a different ethical code than would be appropriate in surface environments. It is usually easy to instill a conservation ethic within the sphere of interest of an individual but much more difficult to instill such a feeling across many disciplines in any one individual. While introducing Hawaiian biologists to the wonders of Hawaiian caves, Howarth (in press) noted that all were quick to agree with his own conservation feelings on the biological resources, but some have been slow, even recalcitrant, to understand that there might be other resources in the caves and blithely trampled through archaeological, geological, or other wonders. Conversely, geologists and archaeologists have quickly grasped the signficance of their own field only to trample unknowingly through biological resources. Such sensitivity seems to accrue only after long experience in caves, that is, only after the explorer has seen the degradation of cave resources for himself does he realize that he is part of the problem. Unfortunately, there are not enough caves for every beginning explorer to learn this lesson on his own. For example, when a biologist, who had quickly become impressed with the cave fauna and had carefully avoided breaking tree roots or disturbing the animals, was shown some rather nice sand castles built in the volcanic ash by dripping water, his reaction to this relatively rare phenomenon in Hawaiian caves was to suddenly stomp and kick his way through the whole display saying: "Sand castles! They look like just piles of sand to me!" He had seen ephemeral sandcastles on the beach and did not understand that cave sand castles, which might be thousands of years old, often have immense scientific and aesthetic value.

Even though education is an effective long-term strategy for solving conservation problems, it can have capricious results. One hard-core vandal, armed with the additional knowledge from a educational program, can irreversibly negate the beneficial activities of 100 responsible people. The two-edged sword created by education is a real dilemma for which we must find a solution (Wilmut 1972; Day 1980). Recognizing this paradox the Cave Research Foundation requires cavers joining their expeditions in Mammoth Cave and other national parks to sign a joint venture agreement which limits publication of popularized reports of the expedition (Daunt-Mergens 1981).

In caves where the resources are sensitive to human disturbance recreational caving should be discouraged until adequate protection of the resources is assured. Unlike other conservation groups which often publicize their cute fuzzy critters, pretty mountains, monuments, temples, or flowers in order to generate public support, we must be much more restrained in popularizing cave resources

because the increase in public curiosity leads to an increase in cave visitation. This is a paradox, for if the existence of cave resources is not made public, then they may be destroyed through ignorance during changes in land use.

Management strategies for caves are difficult, for the resources are out of sight, and vandalism or other destructive acts may go undetected. In adddition, caves are hazardous, and safety considerations pose serious management problems, especially for public parks. Search and rescue techniques in caves are quite different from those used above ground. Unfortunately, resource monitoring programs soon tax the budgets of even large organizations. In many cavernous regions of North America, cave managers and users have already had to face this dilemma and have developed management programs. The most successful of these are based on a classification system in which the caves are inventoried for their resources and hazards (Trout, 1978). Each cave is then placed into one of the four or five categories. Caves in the most lenient category are open to the public with few restrictions. The other categories require increasing levels of control up to the most restrictive group that includes those caves containing highly significant resources or that are particularly dangerous. For these caves access is severely limited, often by gating. These management policies must reflect the degree of control possible as well as the broad mandate of the land managers involved. Since the national parks have a strong commitment to long term conservation, they should strive for a restrictive policy. Protection of surface environments over caves is essential to the successful conservation of many cave resources.

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