Union Internationale de Spéléologie

International Union for Conservation of Nature

Complete Listing of Guidelines for Cave and Karst Protection

Citation: Gillieson, D., Gunn, J., Auler, A., and Bolger, T. (editors), 2022. *Guidelines for Cave and Karst Protection, 2nd Edition*, Postojna, Slovenia: International Union of Speleology and Gland, Switzerland, IUCN. 112 pp

ENGLISH LANGUAGE

SOME VALUES OF KARST AND CAVES

(1) Effective planning for karst regions demands a full appreciation of all their economic, scientific and human values, within the local cultural and political context.

(2) Managers should recognise that in karst catchments, surface actions result in direct or indirect impacts underground or further downstream.

(3) A good understanding of cave characteristics and their unique values is essential to the improved management of any karst area.

THE SPECIAL NATURE OF KARST ENVIRONMENTS AND CAVE SYSTEMS

(4) Safeguarding natural processes, especially the hydrological system, is fundamental to the protection and management of karst landscapes.

(5) Pre-eminent amongst karst processes is the cascade of carbon dioxide (CO2) from low concentrations in the external atmosphere through greatly enhanced concentrations in the soil atmosphere to reduced concentrations in cave passages. Elevated soil carbon dioxide concentrations are a result of plant root respiration, microbial activity and healthy soil invertebrate fauna. This cascade must be maintained for the effective operation of karst solution processes.

(6) The need for total catchment management is more vital for karst landscapes than many other lithologies.

(7) There are now relatively few pristine karst landscapes and those that remain must be preserved and maintained as a high priority. Elsewhere, the focus must be on the correction of any negative impacts from past and present management practices.

SCALES OF MANAGEMENT IN KARST AREAS

(8) A single management prescription applied to a complex karst hydrological system (or complex integrated cave system) is unlikely to adequately protect ongoing geomorphological and ecological processes across different parts of the system. Management planning must therefore take account of scale factors in the karst system.

(9) The biology of most caves is largely dependent on food sources brought in from the surface environment. The accession of food and energy from external sources is critical to the survival of viable populations of organisms, and the frequency and magnitude of energy inputs into the cave ecosystem is essential to the maintenance of organism populations.

(10) An individual karst hydrological system (or cave system) may contain several components or types of passage, from active stream passages to inactive, higher-level ones, as well as poorly connected relict passages. Each will require a different management prescription.

(11) Within a karst area, some sections may be highly sensitive to groundwater contaminants, while other areas may be less sensitive. Comprehensive land-use planning is therefore needed to protect karst groundwater resources.

RECREATIONAL AND ADVENTURE CAVING

(12) An inventory of caves is desirable as a basis for management. Features of particular interest in each cave should be identified on a map.

(13) A risk assessment is desirable and should cover groups of caves, individual caves, or sections within a cave as appropriate to the site. The assessment should cover both the risk to human explorers and the risk that human explorers pose to the cave. The vulnerability of each type of feature should be assessed to facilitate identification of caves, or zones within caves that are suitable for particular uses.

(14) Management of caving impacts is best approached through a strategic planning process with stakeholder involvement. An appropriate approach is likely to require a combination of initiatives, of which access policy will always play a key role.

(15) Any instructor offering adventure caving should be able to provide evidence that they have received adequate training in safety aspects and in cave conservation.

(16) All cavers should be expected to be familiar with, and to follow, a minimal impact caving code (MICC). Where no national or regional MICC applies to a protected area, a specific code should be devised based on published codes.

(17) Digging, original exploration and research in caves within protected areas should be controlled either via specific agreements or by requiring permits.

(18) Protected area managers are recommended to draw up a plan that can be implemented should a caving accident occur in the area. The plan should be drawn up with involvement from the regional or national caving body and of state bodies responsible for accident and emergency situations, and should include guidelines to minimise the impact of the rescue on the cave and on the surface.

(19) It is totally inappropriate to allow any form of motorised transport into wild caves and wild caves should never be used for running events or for other types of sporting event.

SHOW CAVES

(20) Existing show caves should be managed to the highest possible standards and should work towards compliance with the ISCA Recommended Guidelines, as well as the guidelines provided here.

(21) A thorough study must be conducted to determine environmental and economic sustainability before developing a cave into a show cave.

(22) Safety must be the number one priority for every show cave.

(23) Determining the visitor carrying capacity of a specific show cave is the balance between providing a safe, informative and enjoyable cavern tour experience for visitors and minimising the impact on the cave environment, while achieving economic goals. All three – visitor experience, environmental impact and economic goals – of these factors must be considered.

(24) It is necessary to have a site plan that depicts the surface detail and the underground detail of a cave in order to analyse the potential impact surface works could have on a cave.

(25) Appropriate infrastructure at the entrance of a show cave is essential for maintaining the natural cave environment.

(26) In all new development, whether in existing show caves or at new sites, infrastructure needs should be carefully assessed, designed and installed, taking current best practices into consideration.

(27) The electric lighting network in a cave should preferably be divided into zones, thus enabling only those parts of the cave currently occupied by visitors to be lit effectively. The use of light should be minimised to only illuminate certain features and create an atmosphere that enhances visitor experience.

(28) Effective show cave management is underpinned by monitoring to allow adaptive site management. At a minimum, basic monitoring of the cave, fauna, climate and carbon dioxide concentrations should be carried out according to a monitoring schedule.

(29) Show cave managers should be competent in both the management of the business of the show cave and its environmental protection.

(30) The guides in any show cave play a very important role as the linkage between the cave and the visitor. It is essential that guides are properly trained in the values of the particular cave and in their interpretation for visitors.

(31) All show caves should develop high quality interpretive information to help the public better understand and appreciate the cave environment.

ADVENTURE AND TOURISM ACTIVITIES ON SURFACE KARST

(32) Rugged and remote surface karst habitats may have unrecognised biodiversity and geodiversity values that should be surveyed and assessed as part of the decision-making process about whether to allow adventure and tourism activities on them, under what conditions and where.

(33) Infrastructure necessary to support surface karst activities should be designed and installed such that it has little impact on the karst, both visually and in terms of its integrity and, if necessary, can be readily removed in the future, returning the karst nearly to its natural condition.

SCIENTIFIC RESEARCH

(34) All protected areas with caves and karst should develop policies for the management of research, which should only be permitted following receipt and approval of an application.

(35) Those wishing to undertake research in caves should be able to either demonstrate they are familiar with cave environments and the local Minimal Impact Caving Code, or that they are working with experienced cave scientists who will ensure adherence to the code.

(36) For those caves that have a management plan, there should be a section on research activities.

(37) All researchers working in caves or on karst whether inside or outside of protected areas are recommended to carefully evaluate their proposals, including a comparison of potential benefits with the risk of damage to the environment or cultural values.

(38) There should be an emphasis on minimal sampling methods for fauna, speleothems and sediments, and researchers should commit to publishing results in a form easily understood by the public as well as in academic media. Researchers should commit to equipment removal and site rehabilitation (if necessary) on the completion of the project.

AGRICULTURE AND FORESTRY

(39) Agricultural activity has the potential to cause significant adverse impacts on karst geoecosystems. Protected area managers should (a) give particular attention to any proposed changes in land use and (b) provide guidance appropriate to the type of farming and the particular conditions on the ground in order to minimise impacts on water quantity and quality.

(40) With respect to land use, arable land requires careful soil management to minimise the erosive loss and alteration of soil properties such as aeration, aggregate stability and organic matter content, and to maintain a healthy soil biota. Pasture land should be managed to maintain the vegetation cover, giving particular attention to stocking levels. As dolines provide point recharge, they should be left in their natural state and should never be infilled or used for waste disposal.

(41) Wherever possible, buffer zones should be established around areas of concentrated recharge, such as sinking streams, dolines or other natural openings, as these are conduits for movement of contaminants and pollutants into the subsurface karst environment. On agricultural land, no ploughing should be allowed in the buffer zones and a complete vegetation cover

should be maintained to filter out any sediment in runoff from ploughed land. In forests, the preservation and potential enhancement of the native vegetation in buffer zones is critical

(42) With respect to water quantity, controls should be placed on the amounts of groundwater extracted for irrigation. Rainwater harvesting should be employed to the fullest extent possible.

(43) With respect to water quality, pesticide and herbicide use should be discouraged unless absolutely necessary to control pests and weeds. Fertiliser usage should be reduced and, where possible, natural fertilisers should be used. Buffer zones around areas of concentrated recharge must be respected and chemical applications should not take place during times when the soils are at or close to saturation and there is a risk of overland flow washing chemicals into the karst.

(44) Prior to any logging or forestry activities on karst areas, a procedure is required to inventory and map the area, assess it for sensitivity and/or vulnerability, and develop suitable management prescriptions. Consideration should be given to a prior analysis of the type and magnitude of forestry activities within a specific karst catchment, plus follow up monitoring to ensure how prescriptions were implemented and how well sensitive karst areas were protected.

(45) Natural forests developed on karst terrains, including mature trees and overgrowth forests, must not be clear cut, logged, or subjected to any human impact. Instead, these forests should be rigorously protected by adequate conservation management, so that surface and underground karst environments continue to enjoy the benefits of their ecosystem services.

(46) In areas where native forest has been cleared and replaced by other species, managers should plan for the replacement of the non-native species by the type of forest which is best adapted to the ecological conditions of the site.

EXTRACTIVE INDUSTRIES

(47) There should be a presumption against new mines or quarries in karst protected areas unless it can be shown that there is no alternative source for a mineral that is in short supply and of high economic or strategic value.

(48) Any proposal for a new mine or quarry in karst should be subject to a detailed environmental assessment that considers both features in and on the boundary of the area, as well as the potential for distant impacts via surface water and karst groundwater.

(49) The environmental assessment should describe and assess the value of cave and karst landforms and ecosystems. It should assess whether there are alternative sites for extraction where there would be less significant impacts. Where there are no alternative sites, then there should be a carefully designed buffer protection zone, wherever possible, around significant caves and karst features in order to protect the integrity of the cave ecosystem, as well as the continuity of hydrological processes.

(50) Where there is no alternative to destruction, features should be recorded and, where relevant, removed for scientific study – i.e., record and remove speleothem and sediment for palaeo-environmental study.

(51) Where development is permitted, there should be a well-designed environmental protection system, as well as a monitoring protocol to record conditions during operation and the efficacy of the protection system so changes can be made if needed. There should also be a detailed closure plan that includes appropriate restoration and long-term monitoring, including a bond paid in advance to assure funding for closure will be available.

DEVELOPMENT AND INFRASTRUCTURE

(52) All feasibility studies for construction projects in karst areas should include careful examination of the planned location, a detailed environmental assessment and the size of a protective buffer zone. Where it is possible to move a project or urban development away from a karst area this can be an economic and environmentally positive decision.

(53) Protocols should be developed and applied to deal with the disposal of atmospheric, liquid and solid wastes generated during and following construction. These should extend to the whole of the karst critical zone, which includes the atmosphere, soil, epikarst and upper zone of karst aquifers.

(54) Building codes for karst must be enforced in the same ways as for earthquake or flood prone areas. Urban zoning in karst regions should take into consideration the specificities and fragilities inherent to the karst environment.

(55) A strong science-based legislative planning framework should be implemented at the local, regional and national levels.

(56) Educational initiatives should be put in practice, especially in less developed countries, in order to inform landowners or city dwellers of the fragile nature of karst terrains.

(57) In protected areas, infrastructure should be kept to a minimum and, if possible, be located away from caves and karst features.

(58) A proper protected area management plan should carefully weigh the pros and cons of building structures within the area, tending towards environment and visitor protection instead of providing unnecessary comfort. Large scale infrastructure projects in caves, unless indispensable, should be discouraged.

(59) Hazardous materials should be handled with

great care and properly regulated to minimise releases. HazMat incident first responders should be trained in particular response methods for karst.

(60) Hazardous materials, be they gasoline or other fuels, solvents, sewage or other hazardous wastes should never be flushed into the subsurface. Groundwater investigation and remediation is extremely difficult and expensive. To the greatest extent possible, hazardous materials should be contained and removed on the surface. More detailed investigations of potential environmental impact should be carried out by experienced karst professionals.

WATER SUPPLY

(61) Define protection buffers for karst water sources, such as springs, wells and caves. In these protected areas, protocols should be established on agricultural practices, with proper use of fertilisers and controlled water pumping. Several schemes for the implementation of protection zones in springs have been proposed, but have only been widely applied in Europe and the USA.

(62) Educational initiatives should promote the awareness of both landowners and ordinary citizens in relation to the specificities of karst environments in order to avoid improper disposal of solid, sanitary and hazardous waste.

(63) A robust monitoring system should be established at major springs and selected wells in susceptible and highly utilised groundwater systems in karst. Long term, high resolution remote monitoring is now a possibility in many springs and should be implemented more widely.

(64) Countries should treat karst water as a fragile and finite resource, implementing laws to control and discipline water extraction, as well as allow appropriate funding for quick reaction in case of contamination. In particular, recommendations regarding the proper design and implementation of septic tanks and the location of landfills should be put into practice.

(65) Because little is known about the behaviour of many contaminants in karst environments, proper funding should be made available in order to advance the scientific understanding of this subject.

DEVELOPING EFFECTIVE MONITORING AND MITIGATION

(66) Monitoring is an essential tool in managing and protecting caves and karst resources, especially in protected areas. The results from ongoing monitoring can be used to inform management and to mitigate impacts.

(67) Monitoring efforts should be focused by prioritising natural resources based on their value or significance, their vulnerability or fragility and the severity of actual or anticipated threats or impacts.

(68) Pollution of groundwater poses special problems in karst and should always be minimised and monitored. This monitoring should be event-based rather than at merely regular intervals, as concentrations of solutes and chemical pollutants are commonly highest during low flow periods, however, it is during rainstorms and floods that the greatest load of pollutants is transported through the karst system.

(69) Avoid high frequency monitoring in fragile areas, unless critically necessary, because this can generate impacts of its own. Automated monitoring, if feasible, should be prioritised.

(70) While recognising the non-renewable nature of many karst features, particularly within caves, good management demands that damaged features be restored as far as is practicable.

(71) As far as possible, natural systems and processes in karst areas should be maintained or restored. If intervention is required, the use of nature-based solutions is preferred, especially those which work in sympathy with natural processes and are more environmentally sustainable than engineering solutions.

INVOLVEMENT OF INDIGENOUS PEOPLES IN KARST MANAGEMENT

(72) For any protected area in which there are Indigenous peoples, there needs to be a legal and policy basis for establishing a collaborative management system, with a local management committee. The primary stake- and rights-holders of the committee are the local residents and protected area management authorities, with the secondary stakeholders being the relevant government agencies.

(73) For those karst protected areas in which there are Indigenous peoples, there needs to be a participatory land zonation based on traditional knowledge and customary rights. This should ideally include controlled use zones where some economic activities are practiced, and totally protected zones where nature conservation is the primary objective.

(74) Managers of parks in which there are Indigenous peoples should develop co-management agreements with local communities, written in appropriate language, such that each community has a clearly defined area for its management and economic activities.

(75) Managers of parks in which there are Indigenous peoples should involve local people in protected area management activities. Ranger activities and tourist guiding in caves and on karst walks provides significant employment opportunities and can help to empower the local community. Programmes to educate rangers and guides in the language likely to be used by the majority of visitors and in natural history are essential.

(76) A key requirement for best practice management is the need to provide correct, scientifically accurate information to visitors and to facilitate relevant, low-impact research.