Resolution VII.13

"People and Wetlands: The Vital Link"
7th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971), San José, Costa Rica, 10-18 May 1999

Guidelines for identifying and designating karst and other subterranean hydrological systems as Wetlands of International Importance

1. RECALLING Resolution VI.5, which added "subterranean karst and cave hydrological systems" to the Ramsar classification system for wetland type and urged Contracting Parties "*to assess the significance of karst and cave wetland systems within their territories and to consider their designation for the List [of Wetlands of International Importance]";*

2. AWARE of the important functions and values of karst and other subterranean hydrological systems, including the provision of vital services to human communities as well as intrinsic value for the conservation of biological diversity;

3. RECOGNIZING that conservation and sustainable use of such systems requires unified consideration of both surface and subterranean wetland components;

4. NOTING that IUCN-The World Conservation Union has published "Guidelines for Cave and Karst Protection";

5. GRATEFUL to the Government of Slovenia for having hosted a Central European workshop on this issue in September 1998, which resulted in draft guidelines for applying the Ramsar Criteria to identify karst and other subterranean hydrological systems of international importance, and for completing the Information Sheet on Ramsar Wetlands for such sites;

THE CONFERENCE OF THE CONTRACTING PARTIES

6. ADOPTS for application by Contracting Parties and others the attached:

   a) Guidelines for identifying and designating karst and other subterranean hydrological systems as Wetlands of International Importance, in Annex I, and

   b) the related additions to the Guidelines for completing the Information Sheet on Ramsar Wetlands, in Annex II;

7. URGES Contracting Parties to include and consider karst and other subterranean hydrological systems in their wetland inventories, wetland policies, and wetland management planning, to ensure, as far as possible, the maintenance of the ecological character of these systems and hence of their functions and values.

8. CALLS ON Contracting Parties to renew their efforts to designate appropriate examples of karst and other subterranean hydrological systems for the List of Wetlands of International Importance, taking into consideration the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Resolution VII.11);

9. REQUESTS Contracting Parties to report to the 8th Meeting of the Conference of the Contracting Parties on progress made with initiatives for the conservation and wise use of karst and other subterranean hydrological systems;

10. INSTRUCTS the Ramsar Bureau to integrate, as appropriate, the Annexes to this Resolution into the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Resolution VII.11).

Annex I

Guidelines for identifying and designating karst and other subterranean hydrological systems as Wetlands of International Importance

1. The ***Values*** of karst wetlands are numerous. In accordance with Article 2.2 of the Ramsar Convention, "*wetlands should be selected for the List on account of their international significance in terms of biology, botany, zoology, limnology or hydrology"*. From this perspective the principal wetland conservation values of karst and other subterranean hydrological systems include:

   a) uniqueness of karst phenomena/functions and functioning;
   b) inter-dependency and fragility of karst systems and their hydrological and hydrogeological characteristics;
   c) uniqueness of these ecosystems and endemism of their species;
   d) importance for conserving particular taxa of fauna and flora.

2. In addition to their many natural values, karst systems also have important socio-economic values, which include (but are not limited to) the supply of drinking water, water for grazing animals or agriculture, tourism and recreation. Karst wetland systems may play an especially vital role in ensuring adequate water supplies for human communities in generally dry surface landscapes.

3. ***Threats*** can be generated within or outside of the karst area. In general terms, many "living" karst areas are wetlands, whether surface or subterranean. The subterranean systems are, in many cases, still well-preserved, but due to increasing development pressures they are becoming endangered. The pressures are both direct (visitors to caves, researchers) and indirect, including pollution of all kinds (particularly water pollution; dumping of solid waste, sewage; development of infrastructure, etc.), water abstraction, retention in reservoirs and other uses.

4. To avoid confusion in **terminology**, the formulations "karst and other subterranean hydrological systems" and "subterranean wetlands" should be used throughout. Regardless of genesis, these terms should be used to include all subterranean cavities and voids with water (including ice caves). Such sites would be eligible for inclusion in the Ramsar List whenever the site selection criteria are fulfilled. These terms should also clearly cover coastal, inland and human-made subterranean sites, following the broad approach of the Ramsar definition of "wetland" and thereby offering a high degree of flexibility for each Contracting Party.

5. The specialized technical terminology used to describe karst and other subterranean phenomena makes a glossary indispensable for non-experts. UNESCO's *Glossary and Multilingual Equivalents of Karst Terms* (UNESCO, 1972) can be used as a detailed source of reference, but a simplified glossary is proposed for Ramsar purposes and is provided below at paragraph 14.

6. Information provided for the purposes of Ramsar site designation and management of subterranean wetlands should be according to:

a) what is available (in many cases this may be limited, and subject to future research efforts); and

b) what is appropriate for the scale being considered. For example, local and national management authorities should have access to the full range and detail of information available, whilst a summary will normally suffice for international purposes, notably completion of the Information Sheet on Ramsar Wetlands.

7. Ramsar designation should be considered as part of a mosaic of national and international instruments. In this way, the most representative part(s) of larger karst/subterranean systems might be designated under the Ramsar Convention, with land-use planning controls, etc., applied to achieve "wise use" of the whole system and its catchment area.

8. Site survey and mapping may present special problems and should be done according to practical possibilities. For example, a two dimensional ground plan of subterranean features, projected against surface features, would suffice as a Ramsar site map. It is recognized that many Contracting Parties will not have the resources to generate three-dimensional representations of subterranean sites, and the lack of such resources should not be a barrier to designation.

9. Optimal boundaries for karst/subterranean Ramsar sites would cover whole catchments, but this is unlikely to be realistic in most cases. Site boundaries should, however, cover the areas which have the most significant direct or indirect impacts on the features of interest.

10. In applying the Ramsar Criteria for Identifying Wetlands of International Importance, special attention should be given to unique and representative hydrological, hydrogeological, biological and landscape values. In this regard intermittent karst and thermal springs can be of special interest.

11. The flexible approach of the Convention allows countries to choose the most appropriate boundaries for national or site-specific situations. In particular, designation of either or both single cave and complex systems (for example, with surface and subterranean wetlands) can be envisaged.

12. The Ramsar definition of wetlands (Article 1.1) should be read/understood to include surface and subterranean wetlands, although the Convention text does not explicitly refer to these systems. Text to this effect should be inserted in section IV of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Resolution VII.11).

13. Special consideration should be given to the cultural and socio-economic values of karst and other subterranean hydrological systems and to the fact that their "wise use" must be implemented at both national and local levels. A clear distinction is required between designation, management and monitoring of these wetlands.

14. The following is a glossary of terms relating to karst and other subterranean hydrological systems to be applied when completing the Information Sheet on Ramsar Wetlands:

Allogenic drainage: karst drainage that is derived from surface run-off that originates on adjacent impermeable, rocks. Also known as allochthonous drainage.

Aquiclude: relatively impermeable rock acting as the boundary to an aquifer.

Aquifer: a water-bearing horizon, sufficiently permeable to transmit groundwater and yield such water to wells and springs.

Aquitard: a bed of rock that retards, but does not totally inhibit, the movement of water into or out of an aquifer.

Artesian flow: flow through a confined aquifer where the entire aquifer is saturated and the flow is under hydrostatic pressure.

Autogenic drainage: karst drainage that is derived entirely by absorption of meteoric water into the karst rock surface. Also known as autochthonous drainage.

Backflooding: flooding due to backup of excess flow behind a constriction in a major conduit.

Bedding plane: a depositional lamination in sedimentary rocks.

Bedding plane cave: cave passages guided by bedding.

Blind valley: a valley that terminates where its stream sinks, or once sank, underground.

Breakdown: Synonym for the collapse of caves, or, in American usage, for the debris produced by collapse.

Calcium carbonate: naturally occurring compound with the chemical formula $CaCO_3$, the major component of carbonate rocks including limestone and marble.

Carbonate rock: a rock consisting of one or more carbonate minerals.

Cave: A natural hole in the ground, large enough for human entry. This does not include hydrologically very significant, conduits or fissures. A cave may be a single, short length of accessible passage, or an extensive and complex network of tunnels as long as the hundreds of kilometers in the Flint Mammoth Cave System. Most caves are formed by dissolution in limestone but sandstone caves, lava caves, glacier caves and tectonic caves also occur. In some countries a cave is regarded as being a horizontal opening, as opposed to a pothole, or jama, which is a vertical opening, or natural vertical shaft.

Cave lake: any underground lake, it may be the entrance to a sump, in vadose caves formed by ponding behind banks of sediment or gour barriers.

Chamber: an enlargement in a cave passage or system. The largest chamber currently known, Sarawak Chamber in Sarawak, is over 700m long, up to 400m wide and 70m high.

Classical Karst: the region called Kras in Slovenia, which gave its name to the karst landscape.

Conduit: dissolutional voids, including enlarged fissures and tubular tunnels; in some usage the term is restricted to voids that are water-filled.

Conduit flow: underground water flow within conduits.

Corrosion: the erosion of rock by chemical activity that leads to dissolution.

Doline: a circular closed depression, saucershaped, conical or in some cases cylindrical. Dolines may form by dissolution, collapse, or a combination of these. They are ubiquitous features of limestone karst, but can form in or above any soluble rock; subsidence dolines are developed in insoluble sediment leached or collapsed into an underlying cavernous limestone. The largest dolines in Slovenia, Smrekova draga for instance, are more than 1 km long and over 100 m deep.

Dry valley: valley without a permanent surface stream. It became dry when underground drains formed or were re-opened.

Entrenchment: erosion by a freely flowing stream to form a canyon.

Estavelle: opening that acts as either a sinkhole or a spring, depending upon groundwater level.

Floodwater zone: the zone through which the level of the water table fluctuates, also epiphreatic zone.

Freshwater lens: fresh groundwater found beneath permeable limestone islands or peninsular land masses. It is limited by a water table above and below by a mixing zone between fresh and saline groundwater along the halocline.

Gour: pool formed by calcite deposition. Gours can grow into large dams many metres high and wide. Travertine, gours form in the open air.

Groundwater: a subsurface water that lies below the water table in the saturated or phreatic zone.

Gypsum: mineral or rock composed of the hydrated calcium sulphate, $CaSO_4 .2H_20$.

Gypsum cave: gypsum is very soluble and vadose and phreatic caves can form in it. Largest caves are in the Podolie region of the Ukraine, where the Optimisticeskaja only has around 180 km of passage.

Halocline: the interface between fresh groundwater and saline groundwater.

Hydraulic gradient: the slope of the water table in an aquifer.

Ice cave: a cave in rock filled with permanent ice.

Input point: the start of underground drainage route or aquifer.

Karst: a landscape created on soluble rock with efficient underground drainage. Karst is characterised by caves, dolines, a lack of surface drainage and is mainly, but not exclusively, formed on limestone. The name derives from Kras - the Classical Karst from Slovenia. In this original, temperate, karst the dominant landforms are dolines, but contrasting landscapes are the pinnacle, cone, and tower karsts of the tropics, and the fluviokarst and glaciokarst of colder climates. The term "kras" originally denoted bare, stony ground in the Slovene language.

Limestone: sedimentary rock containing at least 50% calcium carbonate by weight.

Meteoric water: water that originates from any form of atmospheric precipitation.

Moonmilk: fine-grained mineral deposit of calcite, aragonite, formed largely by bacterial deposition.

Output point: a point where water exits from an underground drainage route or aquifer.

Passage: any negotiable part of a cave system, horizontal rather than vertical or sub-vertical sections. Cave passages vary in size and shape, the largest known is Deer Cave, which is up to 170m wide and 120m high, in the Mulu karst of Sarawak.

Percolation water: water moving slowly through the fissure network of a limestone. Usually percolation water enters the limestone through a soil cover. Percolation water accounts for most of the storage in a limestone aquifer, responds slowly to flooding in comparison to sinkhole water.

Permeability: the ability of a rock to transmit water. Permeability may be primary, due to the effects of interlinked porosity or open tectonic fractures, or secondary, due to the dissolutional enlargement of fissures developing conduit permeability.

Phreas: the zone of saturated rock below the water table, within which all conduits are water filled.

Phreatic cave: cave developed below the water table, where all voids are water filled within the phreas. Phreatic caves may include loops deep below the water table, karstic maturity encourages shallow phreatic development just below the water table.

Piezometric surface: the level to which a column of water ascends in an observation well (piezometric tube).

Pit: shaft or pothole from the surface or inside a cave, vertical segment of a gallery.

Pocket valley: a valley that begins abruptly and has no headwaters, having formed from and below the site of a karst spring.

Polje: large flat-floored closed karst depression, with commonly alluviated floor. Streams or springs drain into poljes and outflow is underground through ponors. Commonly the ponors cannot transmit flood flows, so many poljes turn into wet-season lakes. The form of some poljes is related to the geological structure, but others are purely the products of lateral dissolution and planation.

Ponor: also a sinkhole or swallowhole.

Pothole: a single shaft, or an entire cave system that is dominantly vertical.

Pseudokarst: a landscape containing karst-like features but not formed by bedrock dissolution.

Relict cave: inactive cave segment, left when the water is diverted elsewhere.

Salt karst: karst landforms developed upon halite or halite-rich rock.

Shaft: natural vertical, or steeply inclined, section of a cave passage, deepest known shaft is the entrance shaft on the Kanin plateau, Slovenia; it is 643 m deep, with no ledges.

Sink: a point where a stream or river disappears underground, through a choke, or may flow into an open horizontal cave or vertical shaft. The character of sink water, flowing directly and rapidly into an open cave, distinguishes it from percolation water. Sink water is also referred to as sub-surface runoff.

Speleology: Scientific study of caves, including aspects of sciences, such as geomorphology, geology, hydrology, chemistry and biology, and also the many techniques of cave exploration.

Speleothem: general term for all cave mineral deposits, embracing all stalactites, flowstone, flowers etc.

Spring: point where underground water emerges on to the surface, not exclusive to limestone, but generally larger in cavernous rocks. Among the world's largest is the Dumanli spring, Turkey, with a mean flow of over 50 cubic metres per second.

Subcutaneous zone: a zone of generally highly weathered rock that lies below the soil but above the main, relatively unweathered, rock mass of a karst aquifer.

Sump: a section of flooded passage, also siphon.

Travertine: calcareous mineral deposited by flowing water, where plants and algae cause the precipitation by extracting carbon dioxide from the water and give travertine its porous structure. Capillary forces, loss of head and aeration also influence travertine deposition.

Troglobite: a creature that lives permanently underground beyond the daylight zone of a cave. Many troglobitic species are adapted in some way to living in a totally dark environment.

Troglophile: an animal that enters beyond the daylight zone of a cave intentionally and habitually and generally spends part of its life in the underground environment.

Trogloxene: a creature that will enter a cave on occasions but does not use the cave either for temporary or permanent habitation.

Vadose cave: a cave that underwent most of its development above the water table within the vadose zone, where drainage is free-flowing under gravity. The gravitational control of vadose flow means that all vadose cave passages drain downslope, they exist in the upper part of a karst aquifer, and they ultimately drain into the phreatic zone or out to the surface.

Vadose zone: the zone of rock above the water table, with free downward drainage, only partially water-filled. Also known as unsaturated zone, and comprises the soil, a subcutaneous or epikarstic zone, and a free-draining percolation zone.

Vauclusian rising: a type of rising or spring where direct drainage from the phreas flows up a flooded cave passage under pressure to emerge in daylight. Such risings are named

after the Fontaine de Vaucluse in southern France with a mean flow of 26 cubic metres per second. It is vertical and 243m deep. Discharge fluctuates seasonally.

Water table: the top surface of a body of groundwater that fills the pore spaces within a rock mass. Above it lies the freely draining vadose zone, and below it lies the permanently saturated phreas. Individual cave conduits may be above or below the water table, and therefore either vadose or phreatic, and the water table cannot normally be related to them. The water table slope (hydraulic gradient) is low in limestone due to the high permeability, and the level is controlled by outlet springs or local geological features. High flows create steeper hydraulic gradients and hence rises in the water level away from the spring. In France's Grotte de la Luire, the water level in the cave (and therefore the local water table) fluctuates by 450m.

Water tracing: underground drainage links through unexplored caves confirmed by labelling input water and identifying it at points downstream. The common labelling techniques involve the use of fluorescent dyes (uranine, fluorescein, rhodamine, leucophor, pyranine etc.), lycopodium spores, or chemicals such as common salt. The longest successful water trace was in Turkey over a distance of 130 km.

Annex II

Additions to the Guidelines for completing the *Information Sheet on Ramsar Wetlands*

The proposed additions are shown in **bold.** Note that the paragraph numbers shown below correspond to those from the approved Guidelines for completing the *Information Sheet on Ramsar Wetlands*.

3. Name of wetland: The name of the designated site in one of the three official languages (English, French or Spanish) of the Convention (alternative names should be given in brackets). **Alternative or local names for the area should be indicated in brackets**.

6. Area: The area of the designated site, in hectares. **In the case of karst and other subterranean hydrological systems, it is suggested that the area be calculated by projecting subterranean features against the surface.**

7. Wetland Type: **[Note: karst & other subterranean hydrological systems should also appear in the categories *Marine & coastal* and *Man-made*.]**

10. Outline map of site: **In the case of karst and other subterranean hydrological systems, the map should indicate clearly the boundaries of both surface and subterranean features of interest. Subterranean features should be represented by a two-dimensional projection onto the surface. Three-dimensional representations of subterranean features are not a requirement, but are welcomed if available.**

14. Physical features: A short description of the principal physical characteristics of the site, covering the following points where relevant:

    - **hydrogeomorphology (especially for karst and other subterranean hydrological systems)**

    In the case of karst and other subterranean hydrological systems, both surface and subterranean features should be described. Important elements to mention when describing subterranean sites include: temperature, humidity, light level, hydrogeological regime including water movements, and catchment area (if known).

16. Ecological features: **In the case of karst and other subterranean hydrological systems mention both surface and subterranean features of interest.**

19. Social and cultural values: An account (more detail can be given in sections 25-27 below) of the principal social values (e.g., tourism, outdoor recreation, education and scientific research, agricultural production, grazing, water supply **- give special attention to the role of karst and other subterranean hydrological systems in maintaining water supplies in otherwise dry landscapes -** fisheries production) and cultural values (e.g., historical associations, **traditional land-use practices**, religious significance**, landscape values, health values**).

20. Land tenure/ownership: **In the case of karst and other subterranean hydrological systems, refer to ownership of both surface and subterranean features.**

22. Adverse factors affecting the ecological character of the site: **In the case of karst and other subterranean hydrological systems, give special attention to factors outside the site which degrade water quality and quantity.**

27. Current recreation and tourism: **Consider all types of tourism, distinguishing between tourism which is compatible with conservation objectives and tourism which is not sustainable**