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Keynote address: Searching for principles to guide sustainable management of karst: lessons from science

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Abstract

Sustainable management implies the use of resources for the benefit of the present generation without limiting the potential use of the same resources by future generations.

Effective sustainable management will leave the environment in at least as good a condition as when its use first started.

The challenge for managers of karst is to show how this can be achieved and to prove that it is being achieved.

Lessons from science:

1 "Nature to be commanded must be obeyed", Francis Bacon, Lord Chancellor of England, (*'Essays'* 1620).

This idea was re-expressed in the 20th century as 'Design with Nature'.

The message is that if we are to work with Nature and use it to our advantage, then we must first learn to understand natural processes.

2. The epikarst (or subcutaneous zone) is of fundamental importance in the control of autogenic recharge. The epikarst is the uppermost weathered zone of karst beneath the soil. It stores and mixes water and redistributes recharge – and any pollution.
3. Conventional groundwater models should not be applied to karst for management purposes, because karst aquifers have triple porosity characteristics and have laminar and turbulent mixed flow regimes that conventional models cannot handle.
4. The best place to monitor the condition of karst is at the outflow spring, because water flow at springs integrates the effects of all upstream activities, terrestrial and aquatic, autogenic and allogenic.
5. Rocky desertification is the most widespread terrestrial problem affecting karst. Rocky desertification is a process that produces stony ecological deserts. It is a direct consequence of over-population and selfish or thoughtless over-exploitation of timber resources.

Principles of sustainable management

1. Harness the cooperation of society.

   Science is impotent without the understanding and support of society. This implies that sustainable management should proceed by example.

2. Work with Nature.

   In order to conserve resources for future generations, so far as possible, development and conservation should be compatible. Destructive activities such as quarrying should be located on the outflow side of karst groundwater systems.

Attributes of karst that require special consideration during management

- -Karst surface and subsurface systems are integrated and so this renders karst especially susceptible to human impacts.
- -Erosion of soil on karst is essentially irreversible at human time scales.
- -Karst is a repository of natural and cultural history and has unique subterranean ecosystems. These are part of our heritage.