Virginia Cave Board presents in honor of
Virginia Cave Week, Oct. 10-16, 2004

The World Beneath Our Feet

Subterranean Life and the Domain Below the Earth

Presentation of a poster by

Center for Subterranean Biodiversity

Karst Waters Institute
P.O. Box 537
Charles Town, WV 25414
www.karstwaters.org

Karst Waters Institute

DCR
Virginia Department of Conservation & Recreation
State Parks • Soil & Water Conservation • Natural Heritage
Chesapeake Bay Local Assistance • Land Conservation
Outdoor Recreation Planning • Dam Safety & Floodplains

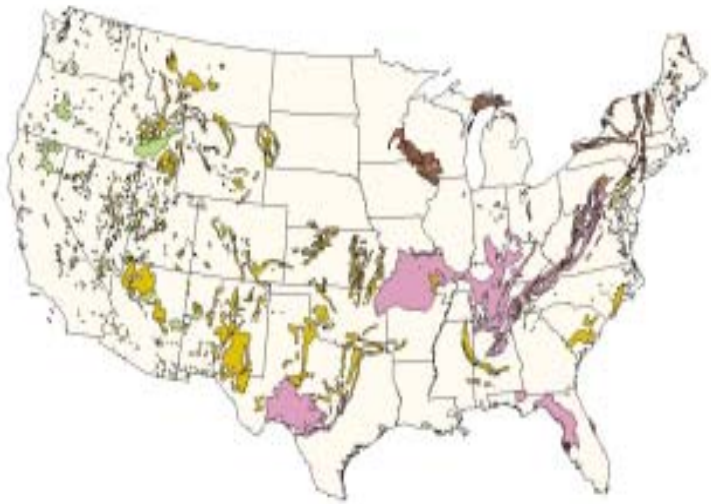
Have you ever thought about the world that lives below the ground you walk on each day? To the surprise of many, this cold and dark world is the home of many unusual and rare species. Because of this diversity and rarity, the subterranean fauna represents an important conservation concern.

When most people think of the subterranean landscape the first image that comes to mind is a cave, a window to a new and dark world. Caves occur in karst landscapes covering 15% of the Earth's surface. Karst landscapes typically occur in carbonate rock as the result of dissolution of the rock by chemical action rather than erosion. In the U.S., karst landscapes account for 20% of the total land area and 40% of the land area east of Tulsa, OK. Caves also occur in other landscapes, especially lava beds. In the U.S., lava tubes are common in Hawaii and Idaho. Other even more inaccessible subterranean habitats occur in the spaces between stones deep in a stream or beach and in cavities with no opening to the surface.

Caves are the most widely recognized subterranean landscape. There are more than 100,000 caves known from Europe and nearly 50,000 known from the U.S. In the U.S., more than one third of the counties have at least 1 cave. The distribution of US caves corresponds with the major US karst systems as seen in the figure.

Distribution of caves in the continental U.S.

Map of the major karst regions of the U.S.



Significant numbers of caves occur in the karst regions of the Appalachians, Interior Low Plateau (KY, TN, AL), FL Lime Sinks, Ozarks (MO, AR, OK), Driftless Area (IL, IA, WI), Edwards Plateau (TX), Guadalupe Mountains (NM), Black Hills (SD), and the Mother Lode Karst (CA). The longest cave in the world is Mammoth Cave, KY which is more than 500 km long.

Caves come in many sizes and varieties, but all caves share two important characteristics: complete darkness away from the entrance and reduced environmental variability relative to surface conditions. Within caves three distinct communities exist: aquatic communities that live in cave streams with a resource base of dissolved and particulate organic matter of surface origin; terrestrial riparian communities that live on stream banks with a resource base of particulate organic matter stranded by stream fluctuations; and the community living in terrestrial transitory organic matter that is concentrated within a few hundred meters of the surface with a resource base of organic matter derived from the activities of animals moving in and out of the caves.

Worldwide more than 10,000 caves have been biologically investigated. In the US, the description of cave species began as early as 1844. Through the continued effort of many scientists, over 1,300 cave and associated subsurface species have been described while several times this number remains in undescribed species.


Photo by H.H. Hobbs III


Photo by H.H. Hobbs III

The long evolutionary history of cave species has resulted in unique characteristics of subterranean populations.

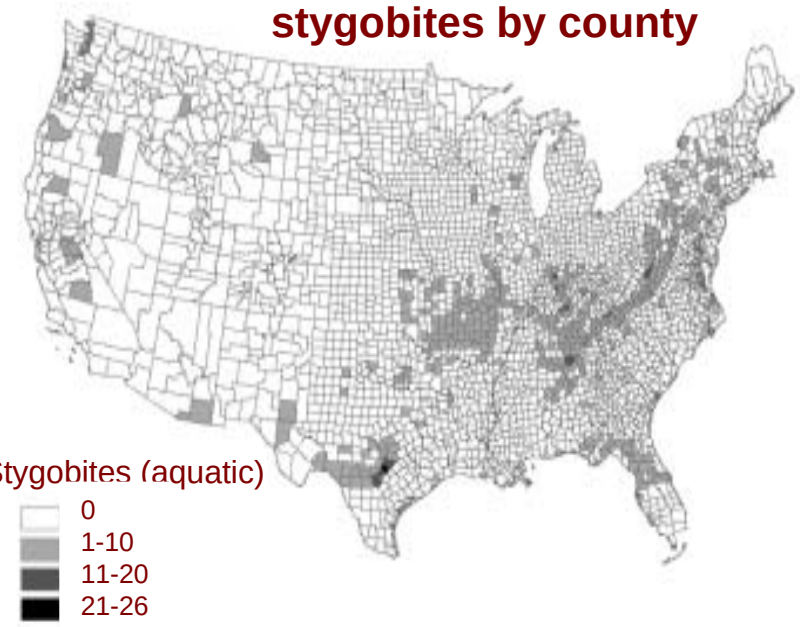
- **loss of eyes**
- **loss of pigment**
- **elongated appendages and antennae**
- **elaboration of other non-optic sensory structures**
- **delicateness of form**
- **increased metabolic efficiency**
- **life history modifications, including increased longevity**

The pictures of the northern cavefish *Amblyopsis spelaea* and the cave crayfish *Orconectes inermis* illustrate the distinctiveness of cave dwelling species.

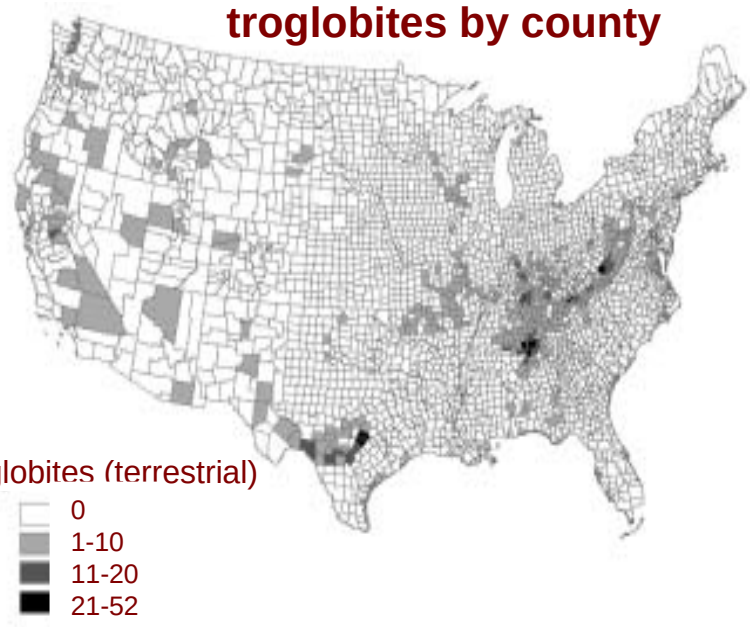
Note to Virginians: although Virginia has numerous cave-adapted invertebrate species, neither blind cave fish nor blind crayfish have been found in Virginia's caves.

The distribution of obligate aquatic and terrestrial cave dwelling species, stygobites and troglobites respectively, in the US is illustrated in the maps below. From these maps, overall trends show that diversity of cave dwelling species decreases to the north and to the west. Less than 17% of US counties have even one obligate stygobite or troglobite. Additionally, 23 counties comprising less than 1% of the land area of the 48 contiguous states account for over 50% of the terrestrial species and subspecies and 18 counties comprising less than 1% of the land area account for over 50% of aquatic species and subspecies.

Distribution of aquatic stygobites by county

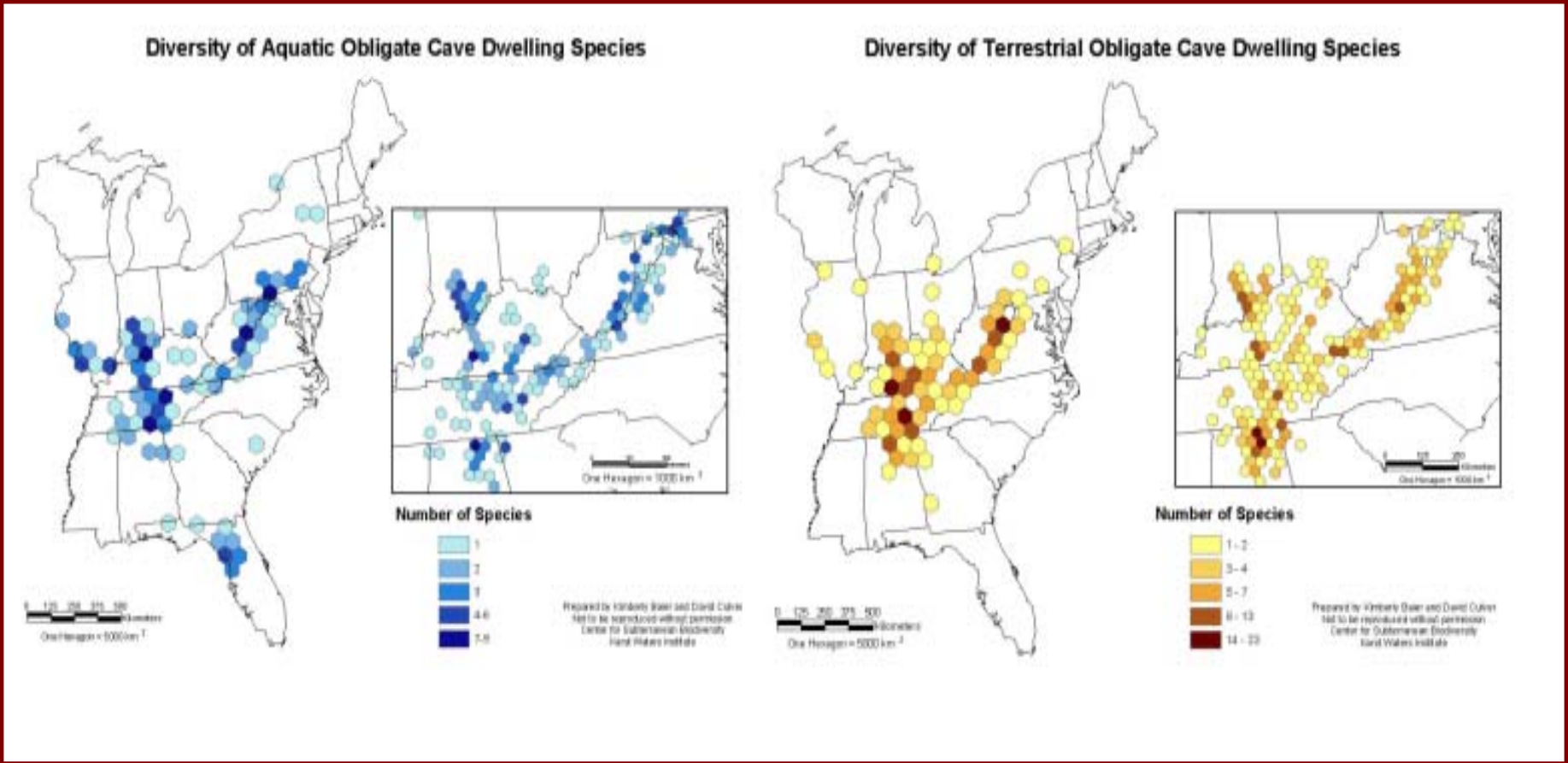


Distribution of terrestrial troglobites by county

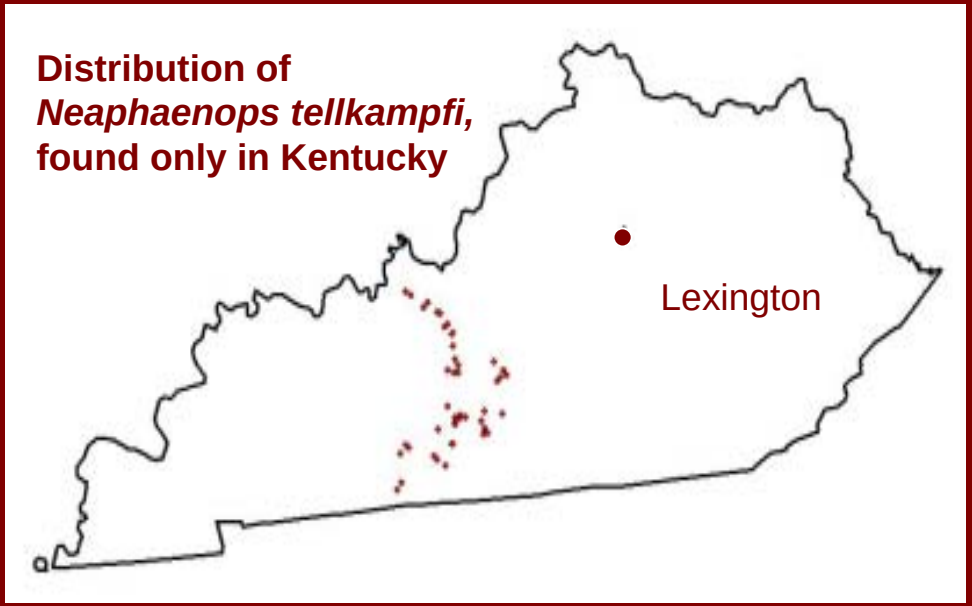


The distribution of subterranean species exhibits several “hot spots.” These are areas where the concentration of cave dwelling species is unusually high. Hotspots include northeast Alabama (troglobites), southcentral Texas (stygobites and troglobites), central Kentucky (stygobites and troglobites), and eastcentral West Virginia (stygobites).

At all scales of analysis, the distribution of obligate cave animals is highly clumped, as can be seen here at the scale of both 1,000 and 5,000 square kilometers. The distribution of stygobites and troglobites differ in many details, and stygobites tend to be more broadly distributed.



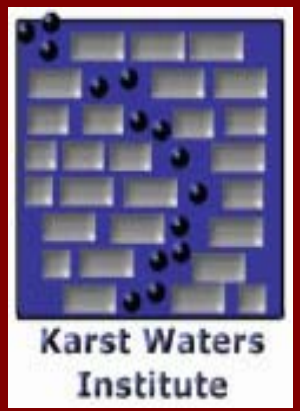
Even "common" species such as the cave beetle *Neaphaenops tellkampfi* have very restricted ranges. Known from less than 50 caves in an area of less than 10,000 km^2, it probably is a complex of several nearly identical species that invaded caves independently. A predator, *N. tellkampfi* typically eats the eggs of crickets.



Subterranean ecosystems are fragile and can be seriously harmed by minor intrusions. Because subterranean species are vulnerable to water pollution and over use, they act as sentinels of ground water quality. To protect these subsurface habitats, you must protect the surface habitats because any environmental degradation on the surface has subsurface effects.

At least 10 US cave dwelling species are extinct as a result of human activities and more than 95% are considered vulnerable or imperiled. In the US, 61% of the described species are found in a single county and about half of these are known from a single locality. Overall, 69% of terrestrial species are single county endemics and 20% are state endemics, while only 44% of aquatic species are single county endemics and 30% state endemics.

Because subterranean species suffer from the attitude "out of sight…out of mind," they are often neglected in decisions concerning conservation priorities. There are too many subterranean species at risk to deal with them one at a time. The most efficient and effective conservation solutions are to protect habitats of as many species as possible while using minimum resources. With over 50% of species occurring in less than 1% of the landscape, it is possible to conserve a large percentage of at-risk species by focusing habitat conservation efforts in areas of high concentration. Protection will take creativity, commitment, and the involvement of local communities working in partnership with nonprofit conservation groups and government agencies in those areas that are home to an abundance of life underground. There is an urgent need for the growing awareness of the biological value of these areas and also a need for greater public awareness and appreciation.



For more information, contact

Center for Subterranean Biodiversity

Karst Waters Institute

P.O. Box 537

Charles Town, WV 25414

www.karstwaters.org

Poster development supported by Cave Conservancy Foundation