

Tree roots in small excavation in the Ossuaries Chamber in Victoria Fossil Cave at Naracoorte, indicating how they have penetrated the sediment. Photo: Steve Bourne.



## THE ROOT OF THE PROBLEM IN VICTORIA FOSSIL CAVE AT NARACOORTE

– Tom Aley\*

Steve Bourne reported in the December 2008 ACKMA Journal that tree roots had been discovered penetrating the ceiling and into the floor of the Ossuaries Chambers in Victoria Fossil Cave at Naracoorte. The tree root penetration of these extremely significant chambers certainly has the potential to damage the fossils and perhaps damage the stratigraphy of the fossil deposits on the floor.

Steve explained that the land overlying the chambers had been farmland for many years but has now been planted to native tree species. The fossil deposits show no sign of previous damage from tree roots so tree root penetration into these chambers is apparently a new occurrence.

The brief article suggests that current dry conditions, previous road building over the cave, and possibly planting of species that are not truly native to the area may provide the explanation for the new management problem.

The 13th ACKMA conference was held at Naracoorte and Mt. Gambier and had a theme of *The Water Below*. I was invited by ACKMA to give one of the papers and Cathy and I certainly enjoyed the whole gathering and the chance to see the

wonderful caves. While there I recall reading a newspaper article about increasing salt concentrations in groundwater used for irrigation and that this was damaging grape vines in the irrigated vineyards.

A rule-of-thumb for agricultural irrigation in semi-arid areas is that about 30% of the applied water should infiltrate below the rooting depth of the agricultural plants to flush salts downward. One result of this is to increase the salinity of the underlying groundwater system, especially if salts are already concentrated in deeper layers of the soil (almost certainly the condition in the Mt. Gambier area).

Returning to the tree roots in Victoria Fossil Cave, the past agricultural history of overlying lands may be important. Under pre-agriculture conditions it is possible that the salinity of the subsoil was great enough to limit vertical development of tree roots.

With agricultural activity (especially if it involved irrigation) salts might have been leached downward out of the soils. Increased runoff from the road would also have increased salt leaching. When agricultural use of the land ended and trees were

planted the vertical development of tree roots was no longer limited by salinity in the soil and roots are now able to enter the cave chambers.

If the mechanism I suggest is correct, then a management approach of searching for the 'guilty trees' is probably not the right strategy. What may be needed is to remove the trees and then establish a more shallow-rooted vegetative cover (probably grasses).



Tree roots hanging from the cave ceiling in the Ossuaries. Photo: Steve Bourne.

Lateral root growth of up to 30 meters or so from the trunk of the trees should be anticipated. While the loss of the planted trees would be unfortunate, protection of the cave is paramount. This event once again demonstrates that one cannot manage a cave without also managing the land that has the potential to impact the cave.

Many years ago while working on my forestry degrees I did some studies of roots in caves in the Mother Lode region of California and tried (without much success) to develop a key for identifying tree roots to species. A number of species have roots

that physically look essentially the same, but I am sure the species could be identified with DNA protocols. (DNA would probably be the best way to identify the species that have roots that have entered Victoria Fossil Cave).

The deepest roots I observed in California caves were about 23 meters below ground surface. As far as I know the record depth for tree roots was for *Juniperus utahensis* in a mine in Utah at a depth of 120 meters. I suspect that re-establishment of this species and Pinion pines in the area overlying Lehman Caves, Great Basin National Park, Nevada (USA) is at least part of the explanation for the increased desiccation of features in the cave. I would expect that similar conditions could exist over Australian caves where Radiata pine (*Pinus radiata*) plantations have replaced native species.

In Hanging Gardens Cave, California, tree and shrub roots have penetrated stalactites for over a meter and now extend below the tips of the speleothems. About 70% of the carbon dioxide uptake in trees is respired through the roots as carbon dioxide and, in the presence of water flowing along the root channel, this can result in dissolution of the penetrated speleothems and their ultimate destruction.

At Oregon Caves, Oregon Caves National Monument, Oregon, one of the routinely interpreted features in the cave was a large tree root located well into the cave. The interpretive staff was disappointed when the root began to decay after park management decided to cut 'hazard trees' that might fall on visitors or block surface trails. Surface and subsurface management had not correlated very well.

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Naracoorte Caves guide Yarrow Lee assisting to remove tree roots in the Ossuaries. Photo: Steve Bourne.