PERSISTENT COLIFORM CONTAMINATION IN LECHUGUILLA CAVE POOLS
Response: Davis Forum

ANDREA J. HUNTER
Hunter Environmental Associates, Inc. 3570 Basin St. Fairbanks, AK 99709 USA
DIANA E NORTHUP
Biology Department, University of New Mexico, Albuquerque, NM 87131 USA
CLIFFORD N. DAHM
Biology Department, University of New Mexico, Albuquerque, NM 87131 USA
PENELOPE J. BOSTON
Department of Earth & Environmental Science, New Mexico Tech, Socorro, NM 87801 USA

Rationale for recommendations limiting certain drinking water resources and research study site access is tri-fold.

1) The level of total coliform is beyond the acceptable level (0 colony forming units/100 ml) recommended by the EPA (EPA, 2005). Iodine tablets have proven successful with killing bacteria and viruses in water over time; however, consuming more than 0.5 to 1 ppm per day (1 liter of water correctly diluted equals ~1.19 ppm iodine concentration) of residual iodine is not recommended, especially for those who are iodine deficient or have known thyroid problems (Singer, 1995). Boiling the water or using a water filter would not be the lightest solution (given the added gas and filter weight), but it would be the safest.
2) On a world scale, more than 90% of species diversity is found in the microbial world — hence, micro-organisms are tremendously important in the context of biodiversity (De Poorter, 1998). Introducing a non-native organism into a new environment can lead to disturbance of the native micro-flora and the extirpation of viable microbes.
3) Costly and time-consuming microbial longevity studies have been in place since the early 1990s by numerous researchers. An influx of coliform bacteria to these water-resource sites may well disturb the native communities currently being studied. Unless researchers and explorers can develop methods to continue exploration without disturbing the microflora, then these areas should remain off limits until at least preliminary microbiological studies have been completed.

The campsite at Red Lake was closed due to coliform contamination in the soils, on surfaces, and in small pools around Red Lake itself including the outer and inner surfaces of the siphon hosing and the spigot (Boston, 1999; Northup *et al.*, 1997; Northup *et al.*, 2000). Continuing to camp at this site, while coliforms are still apparently present, will only further spread the organisms onto the trails and further into the cave via cavers' boots. We fully expected this to be a very short duration closure, based on the common notion that coliforms will die out very quickly in low nutrient environments. We were very surprised that this did not occur. Hair, lint, sweat and dirt from clothing or boots can all add organics to water resources, and this organic source may have helped the organisms to remain longer. When it is necessary to obtain water, via a pitcher directly from the poolside (i.e. Big Lake and Lake Louise), clean (preferably sterile) rubber gloves and boot covers should be used to help prevent further contamination. When water is obtained from a siphoning hose via a spigot, clean gloves should be worn and precaution should be taken not to touch the nozzle directly. Contaminants and introduced organisms from dirty hands could migrate up the hoses creating 1) slime-coated hoses and 2) pool contamination.

Crossing unexplored water leads with minimal contamination would involve having explorers strip off their clothing, bathe in anti-bacterial wipes (including helmet/light), remove boots/socks and put on clean slippers (rubber soles that can also be wiped), then inflating a clean rubber raft (applying anti-bacterial wipes or solutions to the bottom) and getting into it without touching the water. Paddles would need to be cleaned and wiped with anti-bacterial wipes and all gear/clothes placed into a large plastic garbage bag and transported in the raft. Research slides hanging in the pools would need to be left undisturbed with minimal water turbulence.

As an explorer (Hunter, 2005), I understand the frustrations when an obstacle impedes forward movement into new leads. However, the cave will always be there, but once opened to exploration, if not approached very carefully, the organisms we wish to study may not be.

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