

From the Los Angeles Times

## Going below the surface

**It's been a rule in the backcountry for decades: Unfiltered water is unsafe. Now, research of remote Sierra sites shifts the blame for illnesses.**

By Linda Marsa

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Bob DERLET drinks his water straight — without fancy filters or chemical treatments. He leans face down into Delaney Creek, which flows directly down into Tuolumne Meadows from the Sierra Crest, taking healthy gulps from the rushing stream, and then fills his water bottle. It's nearly noon on an early summer day, and temperatures are hovering in the mid-80s. After a rigorous two-mile ascent in altitudes around 9,500 feet, the pristine mountain water is indescribably refreshing: no chemical aftertaste of tap water and chilled to perfection by the Sierra's melting snowpack.

"No one camps above here. There's no livestock or park animals so there's little chance of contamination," says Derlet, gesturing toward Mt. Dana in the distance and the lush, grassy alpine meadow surrounding the creek.

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### FOR THE RECORD:

**Giardia** —A story in last week's section about backcountry water advised backpackers and hikers to bury human waste 10 feet from the water. Many sources recommend it be buried at least 100 feet from water; some say 200 feet. Also, one of the captions referred to giardia as a bacterium. Giardia is a protozoan.

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Derlet should know. The emergency room physician and professor at UC Davis School of Medicine in Sacramento has spent part of the last five summers hiking about 2,000 miles throughout the Sierra and stopping at spots such as Bubbs Creek in Kings Canyon and Vogelsang Lake in Yosemite to test the water at 100 sites

each year for the presence of microscopic miscreants.

It's a Herculean task, but he's driven by a desire to meld his lifelong passion for the outdoors with his expertise as a scientist. Because half of California's fresh water comes from the Sierra Nevada, Derlet is curious about pollution levels in the wilderness and what that would mean for the future of a state whose growth is dependent on clean water. Funded by grants from the Wilderness Medical Society, Derlet's field work is part of a projected 20-year water quality study.

But what he's uncovered already is surprising, both for the seasoned wilderness traveler as well as the day hiker who stares longingly at a gushing river and wonders whether it's safe to take a slug. At many trails and backcountry camps throughout California, signs warn visitors off casual sipping. But are the dangers of *Giardia lamblia*, *E. coli*, *Cryptosporidium* and other bugs that wreak intestinal havoc grossly exaggerated?

Derlet thinks so, and his research reveals that the water is much cleaner than most people believe. His findings thrust him into the middle of a long-simmering controversy that's blatantly at odds with what many state biologists preach and what wilderness classes teach: Purify water before drinking. But is that really necessary? Do those high-priced pumps, chemical disinfectants and elaborate filtration gadgets truly merit a place in the backpack?

"It's a huge debate," says Ryan Jordan, a biofilm engineer at Montana State University in Bozeman who has studied pollution in wilderness areas.

The available scientific evidence, which is admittedly limited because of the scarcity of funding for testing wilderness water quality, confirms Derlet's findings. The threat is

comparable to the chances of beachgoers being attacked by a shark, according to University of Cincinnati researchers who studied the danger giardia poses to backpackers, namely "an extraordinarily rare event to which the public and the press have seemingly devoted inappropriate attention."

And yet, some doctors say that backcountry water is not safe to drink, even if it looks clear as glass. Defecating wildlife and encroaching hordes of campers who aren't environmentally savvy have spoiled the lakes, rivers and streams of the pristine wilderness. "Infectious agents don't change the water's appearance. You can't taste, smell or see them," says Dr. Paul Auerbach, an emergency room physician at Stanford University in Palo Alto and author of the standard text "Field Guide to Wilderness Medicine." "All it takes is a few beavers upstream, and you're in big trouble."

The National Park System and the U.S. Forest Service urge backpackers not to drink untreated water, and it has become an accepted article of faith among wilderness travelers that a water cleanser is as indispensable as a tent, compass and boots. Veteran backpackers like Jim Metropulos, who handles water quality issues for the Sierra Club in Sacramento, view water purification devices as an insurance policy that "provides a backup layer of security."

Little wonder people are convinced that drinking untreated water these days is inviting trouble. A bad case of the runs can ruin a backpacking trek, and you can end up chained to the bathroom for weeks if you contract giardiasis, the intestinal scourge that ignited the water purification debate more than two decades ago. "The issue was first widely publicized in the early 1980s," says Derlet. "Because it only takes a small dose, 10 to 25 giardia cysts [infectious particles of the parasite], to become sickened, people were alarmed."

Some point the finger at pump makers for inflating the risks and making backpackers ultra-vigilant about purifying water. "The advent of affordable water filters kick-started this whole debate," says Jordan, who is also editor of Backpacking Light magazine. "There's a lot of money in water filters: They cost anywhere from \$40 to \$100 a pop, and there are several million backpackers in the United States, so do the math.

The water filter industry has instilled in people a mantra of 'you just never know,' rather than trying to educate them about the differences between good water sources and bad ones."

The results of a study conducted in 1993 by researchers at the University of Nevada in Reno and the U.S. Geological Survey in Sacramento were eye-opening. Of 41 backpackers who trekked to the Desolation Wilderness in Eldorado National Forest west of Lake Tahoe, six of them were stricken with cramping, diarrhea, nausea and bloating. Yet lab tests revealed that none of them was infected with giardiasis. Researchers didn't determine exactly which bugs were sickening the backpackers, but they think the culprits were the usual suspects — *E. coli*, salmonella or *Campylobacter jejuni* — which they might not have contracted from drinking water.

Taking this research one step further, the scientists analyzed the backcountry water for giardia. The bug was indeed present, but at such low levels of concentration — just a few cysts per 100 gallons — that backpackers, on average, would have to drink 250 gallons a day to become ill.

"People tell me they went on a five-day backpacking trip and when they got back they got diarrhea, so they assume they had giardia," says Derlet. "But when I ask them if they've been tested for it, they haven't. But they're still convinced that it has to be that. The fact is that if someone develops diarrhea after a wilderness trip, they most likely got the bug before they entered the wilderness or from someone while they were on the trip, not from the water."

The 1995 University of Cincinnati survey of 48 of the 50 state health departments in the United States came to similar conclusions. Only two of the agencies considered giardia a problem for backpackers, and even then, they had no data to support this concern. Although giardia sickens about 20,000 Americans each year — outbreaks have been linked to contaminated drinking water in small towns, food handlers and child-care workers who are infected when they change diapers — the researchers didn't find any evidence that wilderness water is a cause. "Neither health department surveillance nor the medical literature," they note, "support the widely held

perception that [giardia] is a significant risk to backpackers."

The reality is that poor personal hygiene, not contaminated water, "is to blame for people getting sick in the backcountry," says Gregg Fauth, wilderness manager for Sequoia and Kings Canyon national parks. Diarrhea-causing bugs, such as giardia and its cousin, *Cryptosporidium*, two parasites that live in the intestines of animals and humans, are transmitted through fecal matter — primarily by people who don't practice good sanitary habits, such as washing their hands or properly disposing of their feces, which should be buried at least 10 feet away from the water.

The typical chain of events is that hikers or backpackers go to the bathroom, then don't wash their hands thoroughly, if at all. Afterward they make dinner or even share a snack and contaminate the food with fecal matter, along with any disease-causing germs that were hitching a ride in their intestines. Giardia can even be spread by touching surfaces — eating utensils, camping gear, water filtration pumps — that are contaminated with feces from an infected person.

"We are so dependent on convenient sanitation that when people go out in the wilderness," says Dr. Howard Backer, a water purification expert and a past president of the Wilderness Medical Society, "they fall apart, and their habits drop to Third World standards."

In light of this growing evidence, Derlet decided to do some testing of his own — not only to debunk some myths, but also to figure out ways to preserve wilderness water for future generations. Starting in early May until the first snowfall in October or November, Derlet shoehorns wilderness forays into his busy schedule of teaching, research and stints in the emergency room, racking up 24 miles on a day hike, during which he hits about 10 places, or taking three-day backpacking trips to visit more than 20 spots. In the process, he's become intimately acquainted with the terrain of nearly every lake, creek and tributary off the hiking trails in the Sierra.

By collecting enough information so that pollution patterns become strikingly apparent, he hopes to identify the reasons why some areas become contaminated while others remain pristine. That way, effective steps can be taken to

keep all the waters clean. "Initially, this was instigated by the backpacking water quality debate," he says. "But I also want to come up with some conclusions about which water is always pure, which water is subject to pollution and why that is and what we can do about it."

Lean and lanky, the 56-year-old physician, with his shock of thick, dark hair and long unlined face, is a poster boy for the benefits of clean living. He nimbly climbs up the steep 700-foot incline from the trailhead off of Tioga Road, the two-lane blacktop that traverses Yosemite, to his first stop of the day: Dog Lake in Tuolumne Meadows near Lembert Dome, at the eastern edge of Yosemite. He walks in long loping strides past the lodgepole pines, and the profusion of yellow and red wildflowers that burst into life in the early summer, and kneels at the edge of the water.

"Lake water is better," he says, glancing up. "Most people think the water is better from a nice, running stream because it's so fresh and churned up. But the top few inches of lake water are zapped with ultraviolet rays from the sun, which are a very powerful disinfectant."

Despite his lofty goals, Derlet's testing methods are decidedly low-tech. He carries his equipment in a fanny pack strapped around his waist that is about the size and heft of a tool belt. His routine is virtually the same at each of the sites where he takes samples: He snaps on a pair of blue latex gloves to avoid contamination and then skims a plastic test tube along the surface of the water, collecting just enough to fill the 2-inch rectangular container, which he stores neatly in an ice chest that he stows in his SUV. He dips a thermometer in the water, and then jots down the time, water temperature and altitude on a log to record each visit. The samples will be taken back to his laboratory at UC Davis and tested for such bugs as giardia.

After making the late morning ascent to Dog Lake, he drives along Tioga Road to do a series of hikes into other places in the park, ranging from the highlands of Tioga Pass, where he clammers through packed snow in altitudes that climb to 10,000 feet, to boulder-strewn trails in the lower elevations around Tenaya Lake closer to Yosemite Valley. He finishes up in the early evening after treks along Gaylor, Budd, Snow and

Yosemite creeks to collect samples in designated wilderness areas that aren't heavily trafficked.

It's an arduous day, but what his research reveals so far is encouraging: High Sierra waters are not nearly as polluted as was thought 15 or 20 years ago and contain about 10,000 normal aquatic bacteria per quart, which is not harmful at all. Derlet has mostly found low levels of *E. coli*, primarily in regions below cattle grazing tracts and popular campgrounds, and *Yersinia enterocolitica*, a bacterium from the droppings of migrating flocks of birds, in high country alpine lakes. The most fecal matter he's unearthed has been in the runoff from the melting snow in the spring, when it washes the ground, and sweeps

everything, including manure, into the streams. The only situation in which Derlet treats water is below sheep and cattle pastures, and in slow-flowing warm streams immediately below heavily used campsites. Otherwise, most of the water is clean enough to drink

"I've felt at home in the wilderness for the past 50 years," he reflects, perched on a log near the trailhead leading to Gaylor Lakes in between bites of a tuna salad, fruit and crackers. "I want to do whatever I can to ensure that 100 years from now, we have clean water and clean forests. That why I'm doing this — to contribute to the science to help preserve it and to distill the true science from rumor."

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## TIPS

### Drink responsibly

There are many places in the Sierra where you can safely drink the water, but choose carefully. "If you have a question, then treat it," says Gregg Fauth, wilderness manager for Sequoia and Kings Canyon National Parks. But if you have a hankering for fresh water and don't want to lug a pump or disinfectants that make the water unappetizing, drinking smart can minimize risks of getting sick.

**Don't drink untreated water in places downstream** from livestock pastures and large backpacker camps. "Humans and cattle are the worst offenders," Fauth says.

**Water at higher elevations is safer** because there's less risk of pollution by humans or wildlife. As water travels to lower elevations, it can pick up contaminants along the way.

**Lake water, especially the top few inches, has less bacteria** than running streams because the

rays of the sun act as a disinfectant. And big lakes are better than smaller, shallow lakes because there's more of a surface to sanitize.

**Clean melted snow is less risky** than ice from the surface of a lake or stream because hardy diarrhea-causing bacteria can survive for months on ice.

**Deep well water is considered safe** because the water is filtered when passing through the soil, which removes giardia cysts. Springs bubbling from the side of a mountain are generally safe too.

**Avoid drinking untreated water** from stagnant ponds or slow-moving streams.

**Don't leave home without them:** Alcohol hand gels, which are available in drug stores, are incredibly effective at inactivating bacteria on your hands. "Washing your hands," says Dr. Howard Backer, a water purification expert, "will prevent you from spreading bacteria to your fellow camper when you prepare the food."

— Linda Marsa