'Man-made' Water Has Different Chemistry

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As population growth, food production and the regional effects of climate change place greater stress on the Earth's natural water supply, "man-made" water – created by removing salt from seawater and brackish groundwater through reverse osmosis desalination – will become an increasingly important resource for millions of humans, especially those in arid regions such as the Middle East, the western United States, northern Africa and central Asia.

But the introduction of this life-giving water will bring changes to the environment.

"Water that's been desalted through reverse osmosis contains a unique composition which will induce changes in the chemistry and ecology of aquifers and natural water systems it enters," says Avner Vengosh, associate professor of earth and ocean sciences at Duke University's Nicholas School of the Environment.

A new study by Vengosh and colleagues in France and Israel provides tools to identify and trace this man-made water as it mixes with natural water supplies and, over time, replaces natural waters in areas entirely dependent on desalination.

The study, published this month in the peer-reviewed journal *Environmental Science and Technology*, details for the first time the isotope geochemistry – or chemical fingerprints – of the elements boron, lithium, strontium, oxygen and hydrogen found in reverse osmosis-desalted seawater and brackish groundwater.

Identifying these unique geochemical and isotopic fingerprints gives scientists and water-quality managers a new array of tools for tracing the presence and distribution of man-made fresh water in a region's soils, surface waters and ground waters, Vengosh says.

"We studied the chemistry of water produced in several of the largest desalination plants on earth and found that that composition of the desalted water is totally different from those of natural waters," he explains. "As this water leaks into the environment through poor infrastructure or enters it directly through irrigation, it will be possible to use our new tracers to track the water back to its origin

"It's sort of like a detective who collects fingerprints at the scene of the crime and matches them to the guilty suspect," he says.

Being able to trace water back to a desalinated source through its isotopic and geochemical fingerprints will allow local governments and water utilities to zero in on the problem of valuable water loss and correct it more quickly and efficiently. Moreover, because desalted wastewater can be recycled through the environment and reused as a drinking water source – a process already being used in southern California – the new tools would enable water authorities to trace the relative contribution of desalted water in their system, and to test the effectiveness of their water treatment processes.

"This will be especially beneficial in water-scarce regions like California or the Middle East, where natural water sources are diminishing and made-made waters are becoming the ultimate water sources," Vengosh says. "Given the complexity and variety of man-made fresh water sources being used to replace natural recharge in these regions, traditional tests alone, such as testing for water salinity, cannot provide a single solution."

Global capacities for producing freshwater through desalination are projected to double by the year 2015, he notes. In some regions, diminished natural water supplies already are problematic. In California, which is experiencing one of its worst droughts in decades, new housing and other development is being slowed or stopped under a state law that requires a 20-year water supply as a condition for approval before building can begin. Increased use of freshwater produced through desalination could help resolve this issue, Vengosh says.

Vengosh is a geochemist who is internationally cited for his expertise on the chemical and isotopic composition of water contaminants. His research has led to the development of new, more accurate methods for tracing contaminants in water supplies worldwide, from boron-laden surface and ground waters in the Middle East to radon-contaminated groundwater in the mountains of western North Carolina.

He co-authored the new study with Wolfram Kloppmann, Catherine Guerrot and Romain Millot of the Bureau de Recherches Geologiques et Minieres of France, and Irena Pankratov of the National Water Commission of Israel.

Source: Duke University

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