E coli muddying issues of water quality and food safety

Alison Gillespie

This summer, as a large part of the US suffers through a serious drought, irrigation has once again been extensively used to water crops. To many, it seems like a modern miracle that crop management and technology have become so advanced. However, when some microbiologists look out over the huge metal frameworks spraying the land with water from ditches, rivers, streams, and ponds, they think about bacteria. Specifically, they worry about how little is known about the pathogen *Escherichia coli*, and about future food safety.

Recently, a team working with the US Department of Agriculture's Agricultural Research Service in Beltsville, MD, proved that *E coli* could overwinter in the bottom sediments of creeks and streams. Led by Yakov Pachepsky, the researchers also demonstrated that non-pathogenic strains of the bacteria lived longer when levels of organic carbon and fine sediment particles were relatively high. In addition, the team discovered that *E coli's* survival rate was less likely to be affected by water temperatures than was previously thought. "If we do have reservoirs of microbes in bio-films and slimes, and those waters are used in irrigation systems, then we need to evaluate them. Do they need monitoring? Is there a health risk?", asks Pachepsky.

Ron Turco, a microbiologist from Purdue University (West Lafayette, IN), agrees. "The whole notion that these pathogens die is wrong. They hang around", he says. If, for example, the water pulled from an irrigation ditch is used on a "soft crop", such as berries, it could potentially mean that there's an undetermined food safety risk that isn't being assessed. What is also problematic, Turco continues, is that *E coli's* behavior in open-system environments is still very poorly understood. As more knowledge is gained, it could be that regulations based around die-off will need to be re-evaluated.

In addition to irrigation issues, any new information about the bacteria's ability to live in stream sediments could also have a major impact on urban and suburban water-quality management, given that rules governing sewage spills and runoff from agricultural areas rely heavily on measurements of *E coli* from aquatic samples. Not many people are interested in mud, but it could change our conception of water quality. "There may be mistakes in management because we are not taking into account these variables in sediment", Pachepsky warns. ■

On the origin of (an invasive) species

Pete Mooreside

As the first exotic fishes known to have established breeding populations in the western Atlantic Ocean, two species of venomous Indo-Pacific lionfish (*Pterois volitans* and *Pterois miles*) have achieved a notorious distinction. For more than a decade since their appearance along the Atlantic coast of Florida, these marine predators have dramatically expanded their non-native ranges (http://fl.biology.usgs.gov/lionfish_progression/lionfish_progression.html). Although it's tricky to tell the species apart at first glance, the unmistakable success of the lionfish as an invader is, however, likely due in part to its reproductive abilities; each mature female is capable of producing millions of viable eggs in a typical year, and spawning occurs frequently and regardless of season.

Given the widespread popularity of lionfish among saltwater aquarium enthusiasts, it is speculated that the initial *Pterois* introduction resulted from several deliberate releases of captive animals. But marine biologist Ricardo Betancur (George Washington University, Washington, DC) wanted to learn more about the invasion's backstory. "We were particularly interested in determining whether non-native lionfish populations – observed at locations as far south as northern South America – originated as a result of multiple independent introductions across the western Atlantic, or if they shared a common introduction origin with the invasive populations established off Florida over 10 years ago."

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Invasive lionfish (Pterois volitans) *at Santa Marta, Colombia, in the southern Caribbean Sea.*

To that end, Betancur and colleagues analyzed mitochondrial DNA sequences obtained from 755 individuals collected at six locations in the Greater Caribbean and off Bermuda, including four previously unsampled areas (*J Biogeogr* 2011; doi:10.1111/j.1365-2699.2011.02496.x). Among other revelations, the authors found a striking absence of genetic differentiation in both lionfish species across the region, when compared with relatively greater variation in the allele frequencies observed in native *Pterois* populations. According to Betancur, this suggests that, while the origin of the invasion may be multiple aquarium releases, there's a single epicenter off Florida.

Ultimately, as the lionfish invasion escalates, so does the apprehension of scientists and resource managers, who are concerned about trophic-level effects and other consequences for native reef (including commercially valuable) species. Despite the negative ramifications of biological invasions, such events offer important opportunities for research. "They provide a natural experiment to study marine connectivity and dispersal patterns in real time", Betancur explains. ■