



Using DNA to Identify Nonpoint Pollution

September 2002

In November and December of 2000, the state Department of Health shut down commercial shellfish harvesting in areas of Henderson Inlet and Nisqually Reach. Harvesting was closed because fecal coliform bacteria levels in the two areas were unacceptably high.

Fecal coliform occurs naturally in the gut of warm-blooded animals – such as cows, birds, people and raccoons. It flows into water from contaminated stormwater runoff; waste from farm animals; leaking sewers and failing septic systems; and waste from pets and wildlife. For policymakers and communities seeking to curb water pollution, the challenge is to identify which of these sources are contributing to the problem. Pollution-source DNA typing might be a tool to help answer that question.



What is “pollution-source” DNA typing?

Pollution-source DNA typing is a promising, yet experimental, tool to help identify sources of nonpoint pollution in water bodies. (Non-point pollution is pollution that comes from one or many activities that take place across the landscape.)

The process involves “typing” – or identifying – the types of E. coli bacteria that live within certain species of animals. Some E. coli strains live within several species; others are unique to one given type of animal. For example, a certain E. coli DNA pattern in coyote feces will only be found in coyotes.

Once the E. coli strains are matched with specific species, they’re recorded in a “DNA fingerprint library.”



How does this help identify pollution?

Thurston County staff took samples of surface water, sediment and shellfish from designated areas within Henderson Inlet. The county will be conducting a similar study in Nisqually Reach during 2003.

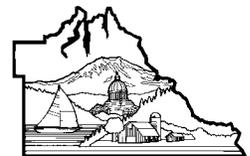
E. coli travels with other fecal coliform bacteria, so the water, sediment and shellfish tissue samples are analyzed in the lab for E. coli bacteria.



Once cultured, the E. coli samples are shipped off to a University of Washington lab to be processed for DNA typing. Once the DNA fingerprint is mapped, it is then matched with E. coli prints from known animals in the DNA fingerprint library.

The larger the feces library, the better the odds for matching the E. coli that’s been isolated from marine water, sediment, and shellfish. Thurston County staff has collected fecal samples from all sorts of wild and domestic animals, as well as samples from sewers and septic systems.

A key part of the analysis involves grouping DNA patterns by geographic location, in other words, where the sample was collected. This helps determine which streams are sending pollutants into the water, and where Thurston County should focus its cleanup efforts.



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How much does this all cost?

The DNA testing procedure is not cheap. The university analysis is \$70 per sample. The culturing of the *E. coli* samples is \$15 per sample. Moreover, there are costs involved in collecting the bacteria. The whole process requires a large number of samples to be collected. In Henderson Inlet, 600 samples were analyzed.



How is pollution source DNA testing different from criminal DNA testing?

Law enforcement DNA work matches DNA to an individual, much like a fingerprint is unique to one person. By contrast, pollution-source DNA testing matches the DNA of the *bacteria* living within the animal. Therefore, it matches groups of animals and not individuals.



What did Thurston County find in the Henderson Inlet Study ?

Henderson Inlet sample sites included one at the mouth of Woodland Creek, two small creeks on Johnson Point, and at a Washington State Department of Health marine monitoring site in the inlet. The study was designed to differentiate between human and animal fecal coliform bacteria sources and determine how often those sources were contributing.



Overall, a total of 27 sources of fecal pollution were identified - birds, beaver, bovine, canine, cat, deer, dog, duck, duck-goose, feline, goose, horse, human, marine mammal, multiple species, muskrat, opossum, otter, porcupine, poultry, rabbit, raccoon, rodent, seagull, sea lion, seal, and some unknown types.

The most frequent sources found in samples from the two small creeks on Johnson Point represented animals living in that rural area – birds, deer, canines (coyotes dogs, foxes, etc.), and rodents. The sources in the Woodland Creek samples reflected the urbanized watershed, with people and dogs being the predominant sources seen.

The study recommendations included undertaking programs to address human sewage and pet waste contamination. The full report can be found on the county website at www.co.thurston.wa.us/shellfish.