Investigation of the efficiency of a microbiological source tracking toolbox: application at the catchment's level.

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The microbiological quality of coastal environments can be affected by fecal pollution from urban and agricultural sources and the presence of marine pathogenic bacteria. Water fecal contamination is one of the most important causes of water degradation worldwide. From the European Water Framework directive point of view, the assessment of microbiological water quality is based on the analysis of fecal indicator bacteria (FIB, Escherichia coli (E. coli) and fecal Enterococci) in water. Those indicators allow estimating the level of contamination but they do not identify the origin of fecal contamination. In recent years, numerous microbial source tracking (MST) methods based on quantification of microbial and/or chemical compounds have been developed for differentiating between sources of contamination.

In our study, we present the application of host-associated Bacteroidales markers and fecal stanols as MST markers in three catchments with contrasted sizes and fecal contamination contexts in Brittany, France. They were monitored together with FIB by monthly sampling over one or two years. The first aim was to investigate the coherence between FIB and the specific markers as a measure of the efficiency of the toolbox at the landscape scale. The second aim was to provide field data on the origin of fecal pollution for hazard evaluation and land use management at the catchment's scale.

The MST toolbox allows the determination of the source of microbial contaminations for 82% of the samples with E. coli concentration higher than present European water quality guideline values and remains effective in the event of their strengthening.

The database, covering three catchments with different size and land use and including samplings in all seasons and during rain events, evidences the variability of the impact of the sources of microbial contamination at the landscape scale. Brittany is characterized by intensive porcine and bovine breeding. Porcine breeding consists mainly in landless production with a controlled management of fecal matter. On the contrary, bovine cattle reared mainly outdoors on grass with a direct input of fecal matter. In this context, fecal contaminations are mainly from animal origin and especially from bovine origin. Livestock have to be excluded from streams by implement fenced parcel around grazing fields, as already point out by previous studies. Moreover at a larger scale the present database highlights specific points on the set up of an effective MST sampling strategy. The definition of sampling points must consider the variability at the landscape scale. Sampling at the outlet of a catchment allows determining the main sources of microbial contamination, while sampling upstream allows identifying the place to develop management strategies. Both scales must be investigated to develop effective management strategies. Finally, rainfall modifies the source apportionment of microbial contaminations via (i) dilution of point sources, (ii) runoff of agricultural areas and/or (iii) exceeding of the waste water treatment capacity of collective plants and/or individual septic systems. Sampling strategies must include this variability that is catchment specific.