Sources for Campylobacter in a catchment facing water scarcity

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World-wide the areas facing water scarcity increase. In Southern Europe predominantly countries like Spain and Italy are expected to be affected regarding to current climate models. But also areas in Western Europe like parts of Germany face periods of drought nowadays. Treated effluent from sewage plants might become an important water source feeding rivers in this areas, even though it is well known that the treated effluent still contains many pathogens and therefore constitutes a potential health risk. *Campylobacter*, generally known to be food-borne, are also found in wastewater and can therefore be transmitted via surface water. Possible routes include water-related recreational activities and ingestion of irrigated food, e.g. strawberries.

Sewage treatment plant should be able to reduce Campylobacter, but what impact on the Campylobacter load of a river do they have under dry weather conditions compared to situations with heavy rainfalls?

Study site and analysed parameter

Study site

- Location: River Swist, Germany (catchment: 289 km^2)
- Six sewage plants, two combined sewer overflow (CSO)
- Upper reaches are not influenced by point-sources

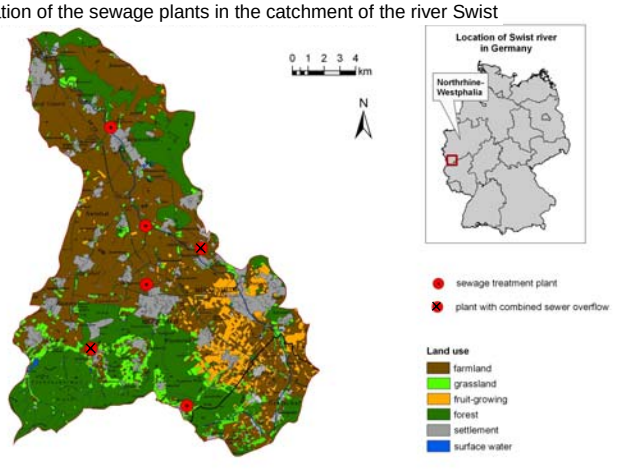
Water samples

- 103 river water samples under dry weather conditions
- Raw sewage (39 samples) and treated effluent (37 samples)
- 10 rain events with samples taken from CSOs and the river up- and downstream

Microbiological parameters

- *Campylobacter*
- *E. coli,* coliform bacteria, fecal streptococci, heterotrophic plate count and clostridia spores

Location of the sewage plants in the catchment of the river Swist



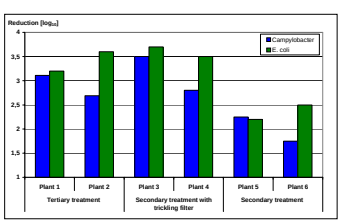


Figure 2: Reduction efficacy of different sewage plant types for Campylobacter and *E. coli*

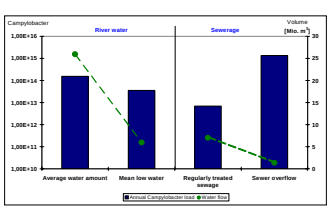


Figure 3: Comparison of the annual Campylobacter load originating from sewage treatment plants, treated wastewater and combined sewer overflow

Results

- Reduction of Campylobacter is depending on the type of plant
- Reduction efficacy of the sewage plants for Campylobacter is slightly lower than for *E. coli*
- Campylobacter in CSO drain is 150-times higher than in regular treated wastewater

Dry weather conditions

- Sewage effluent makes up to 66% of the river water
- 86,4 % of river water samples were positive for Campylobacter
- Campylobacter concentrations do not rise alongside the water course as a consequence of additional sewage discharge

Annual loads

- Campylobacter passing the catchment outlet 1,56 x 10^{14}
- Load from treated sewage is app. 4,5% of the average annual river water load at the catchment outlet
- Annual CSO load 8,7 times higher than annual river water load

Conclusions

- **Sewage plants are an important water source and prevent the river from desiccation in summer**
- **Sewage plants comprising a simple secondary sewage treatment reduce Campylobacter by 2 $\log_{10}$**
- **Enhanced treatment plants comprising a tertiary treatment reduce the Campylobacter in the wastewater effectively**
- **Combined sewer overflow, but not treated sewage, poses the main source for Campylobacter in the whole catchment**
- **Reduction of CSO volume is the most important measure to reduce Campylobacter contaminations**
- **To reduce infectious risks resulting from Campylobacter in the river water, technical solutions that enable the treatment of CSO and provide usable water quality have to be implemented, e.g soil filter**
- **Planning for sewerage systems should focus on the separate handling of rainwater and sewage, to prevent CSO**

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