JDS 3 First Microbiological Results

In contrast to JDS 1 and JDS 2 microbiological sampling was performed not only in the middle of the Danube but also at the left and right river side. It had been observed that the water in the middle of the river was often unaffected by expected high concentrations of microbial faecal indicator bacteria, entering the Danube from wastewater, wastewater treatment plants, or polluted tributaries. Thus, for JDS 3, at some sampling sites, significantly higher concentrations at the river sides were expected. *E.coli* and Enterococci as faecal indicators were chosen for analysis of faecal pollution, according the EU Bathing Water Directive. In addition, total Coliforms were determined. As the results of the first 19 sampling sites (including the additional microbiological sampling sites Inn and downstream Vienna) show (**Figure 1**), at specific sites, markedly higher concentrations of *E.coli* were observed at the left (Kelheim, Oberloiben) or right river side (downstream Vienna until Hainburg and Kliszka Nema).

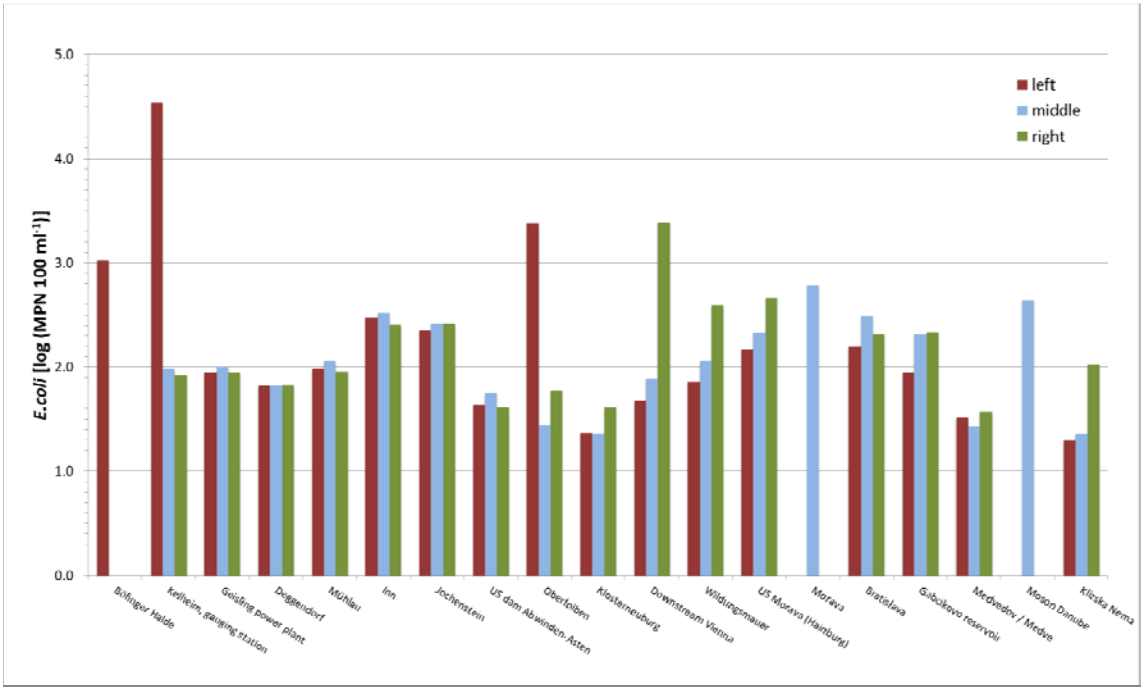

Figure 1: *E.coli* concentrations at the first 19 JDS sampling sites in samples taken left, middle and right of the river. Data were log – transformed: 1 = 10 *E.coli* per 100 ml, 2 = 100 *E.coli* per 100 ml, 3 = 1.000 *E.coli* per 100 ml, 4 = 10.000 *E.coli* per 100 ml, 5 = 100.000 *E.coli* per 100 ml.

For orientation and relation of the observed values to water quality (based on the EU Bathing Water Directive and the EU Water Framework Directive), **Table 1** can be used, which had been developed by KIRSCHNER ET AL (2009). However, it has to considered that the data of bacterial indicators of faecal pollution generated during the Joint Danube Survey are single measurements. It can thus be considered only as a snapshot analysis of (bathing) water quality. According to the EU Bathing Water Directive a sound assessment of bathing water quality is based on biweekly measurements during the bathing season, allowing the calculation of an average value and a 90% and 95% confidence interval of this average.

With only a few exceptions, most *E.coli* concentrations were class I and II (little to moderate pollution) and thus corresponding to excellent (< 100 *E.coli* per 100 ml) or good water quality (<1.000

E.coli per 100 ml) according to the EU Bathing Water Directive. Downstream Vienna (right) the limit value for good bathing water quality is exceeded due to the influence of the wastewater treatment plant of the city of Vienna. However, the measured concentration (2.400 *E.coli* per 100 ml) is within acceptable magnitude. First, this is a low value for sites with direct wastewater influence. Second, this site is not an official bathing site and cannot be used for bathing due to high water velocity. Third, after a few kilometres (at Wildungsmauer), right side values were again already below 1.000 *E.coli* per 100 ml. Surprisingly, at Oberloiben (critical pollution) and Kelheim (strong pollution) elevated values were observed at the left river side. No explanation was so far found for these observations.

Table 1: Microbiologically based classification system of water quality according to faecal pollution (taken from KIRSCHNER ET AL 2009)

Classification of faecal pollution		Class				
		I	II	III	IV	V
Parameter	Faecal pollution	little	moderate	critical	strong	excessive
Escherichia coli EC	in 100ml water	≤ 100	> 100 - 1 000	> 1 000 - 10 000	> 10 000 - 100 000	> 100 000
Intestinal Enterococci ENT	in 100ml water	≤ 40	> 40 - 400	> 400 - 4 000	> 4 000 - 40 000	> 40 000
Total Coliforms TC	in 100ml water	≤ 500	> 500 -10 000	> 10 000 - 100 000	> 100 000 - 1 000 000	>1 000 000

Results for Enterococci and Total Coliforms corroborated the observed pollution pattern, as can be seen in **Figure 2** and **Figure 3**.

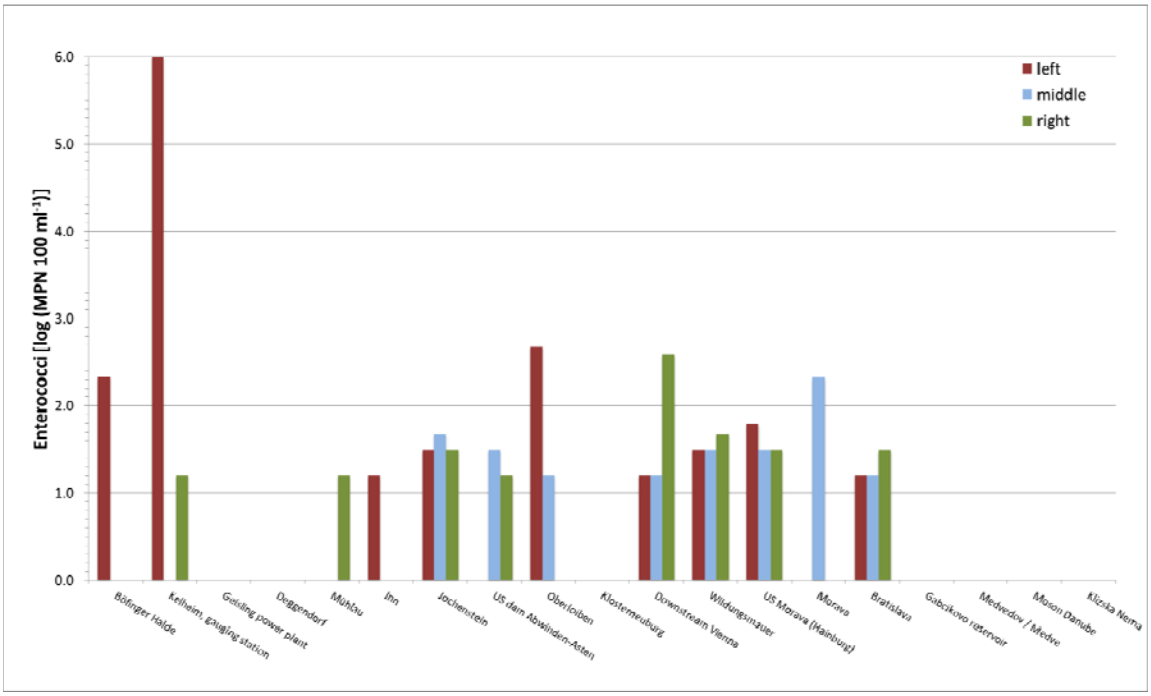

Figure 2: Enterococci concentrations at the first 15 JDS sampling sites in samples taken left, middle and right of the river. Data were log – transformed: 1 = 10 Enterococci per 100 ml, 2 = 100 Enterococci per 100 ml, 3 = 1.000 Enterococci per 100 ml, 4 = 10.000 Enterococci per 100 ml, 5 = 100.000 Enterococci per 100 ml.

Enterococci showed with one exception (Kelheim left) lower concentrations than *E.coli* and exceeded EU-Bathing Water Directive limits of good water quality (400 Enterococci per 100 ml) two times (Oberloiben left and Kelheim left).

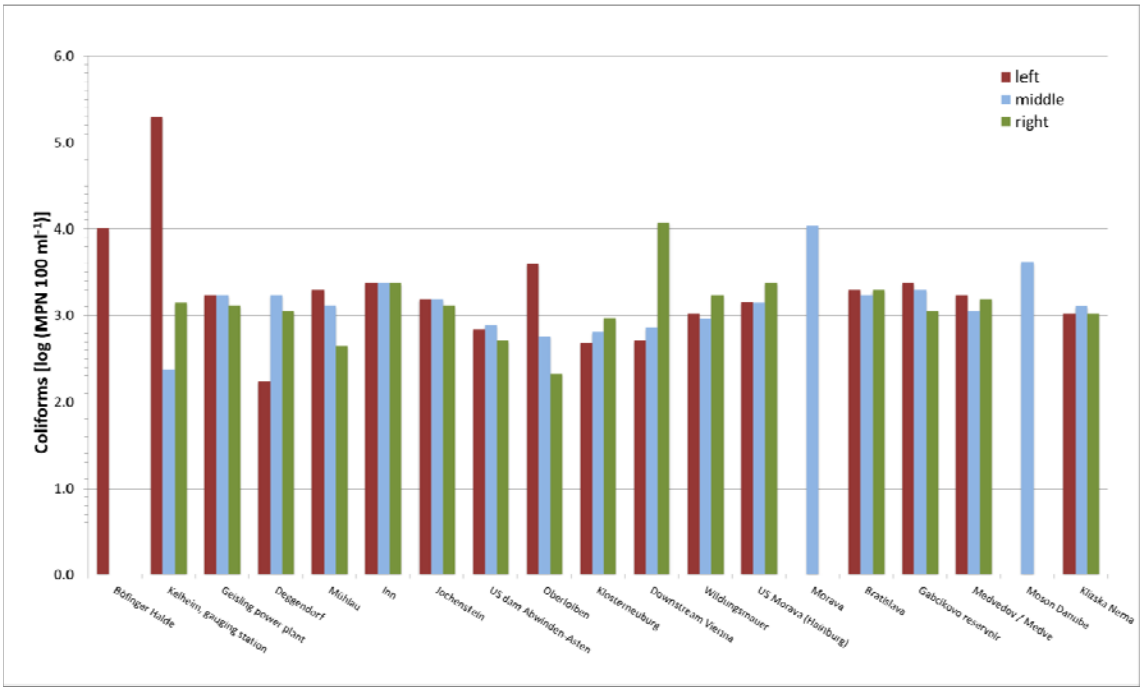

Figure 3: Total Coliform concentrations at the first 19 JDS sampling sites in samples taken left, middle and right of the river. Data were log – transformed: 1 = 10 Coliforms per 100 ml, 2 = 100 Coliforms per 100 ml, 3 = 1.000 Coliforms per 100 ml, 4 = 10.000 Coliforms per 100 ml, 5 = 100.000 Coliforms per 100 ml

Total coliforms exceeded the limits of moderate pollution 4 times (Kelheim left and Downstream Vienna right, as for *E.coli* and Enterococci). In addition, Böfinger Halde and Morava were slightly above this limit.

As a first **conclusion** we can say that most of the Danube sites analysed so far showed little to moderate microbial faecal pollution. Only a few specific sites exceeded limits of good bathing water quality. In most of these few cases this exceedance was moderate, only one site showed strong microbiological faecal pollution. In any case, it has to be kept in mind that the data of bacterial indicators of faecal pollution generated during the Joint Danube Survey are single measurements and can thus be considered only as a snapshot analysis of (bathing) water quality.

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Sponsored by:
- Austrian Science Fund FWF-Project P25817-B22
- I.C.P.D.R.
- Austrian Ministry of Agriculture, Forestry, Environment and Water Management

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