JDS 3 Microbiological Results update (2013, Sep. 10)

The first microbiological results have shown, that the level of microbial faecal pollution of the Danube in Germany and Austria was generally little to moderate (see: Joint Danube Survey website report from Aug. 25). However, left-middle-right sampling revealed two surprising spots of critical (Oberloiben, AUT) to strong faecal pollution (Kelheim, GER) at the left river side. In both cases no reason for the observed increased pollution status was found so far. In addition, in the sample downstream Vienna (right) a critical *E.coli* concentration was found, which was expected due to the discharge of the large Vienna wastewater treatment plant and which lead to increased values in the Danube until the Austrian-Slovakian border. Surprisingly, *E.coli* concentrations dropped significantly by one order of magnitude during Slovakia, despite the merging of the tributaries Morava and Moson Danube, both of which displayed much higher concentrations than the respective stretch of the Danube. *E.coli* concentrations remained at little to moderate levels in Hungary until Budapest. At sampling site "Downstream Budapest", critical pollution levels were observed in the middle and at the right river side. Yet, *E.coli* concentrations were only slightly higher than the limit value for good bathing water quality, despite the fact that the effluent of the new wastewater treatment plant is situated in the middle of the Danube. However, 72 km downstream (Dunaföldvar), a massive increase in *E.coli*concentrations was observed only in the midstream sample, indicating that the wastewater plume of Budapest is measurable dozens of kilometres downstream. Obviously, no mixing of the midstream water with the left and right water masses has occurred. After Dunaföldvar, moderate pollution levels could be observed until the mixing of the Drava tributary in Croatia, which lead to an increase of the *E.coli*concentrations at the right river side of the Danube to critical pollution levels. After Novi Sad (SRB) pollution levels of the Danube were generally critical, and even reached the level of strong pollution after Belgrade. Both, Tisza and Sava tributaries, showed much lower *E.coli* concentrations than the Danube and the increase of microbial-faecal pollution in the Danube can be traced back to influence of the large cities in this stretch. After Pancevo, pollution levels started to decrease significantly.

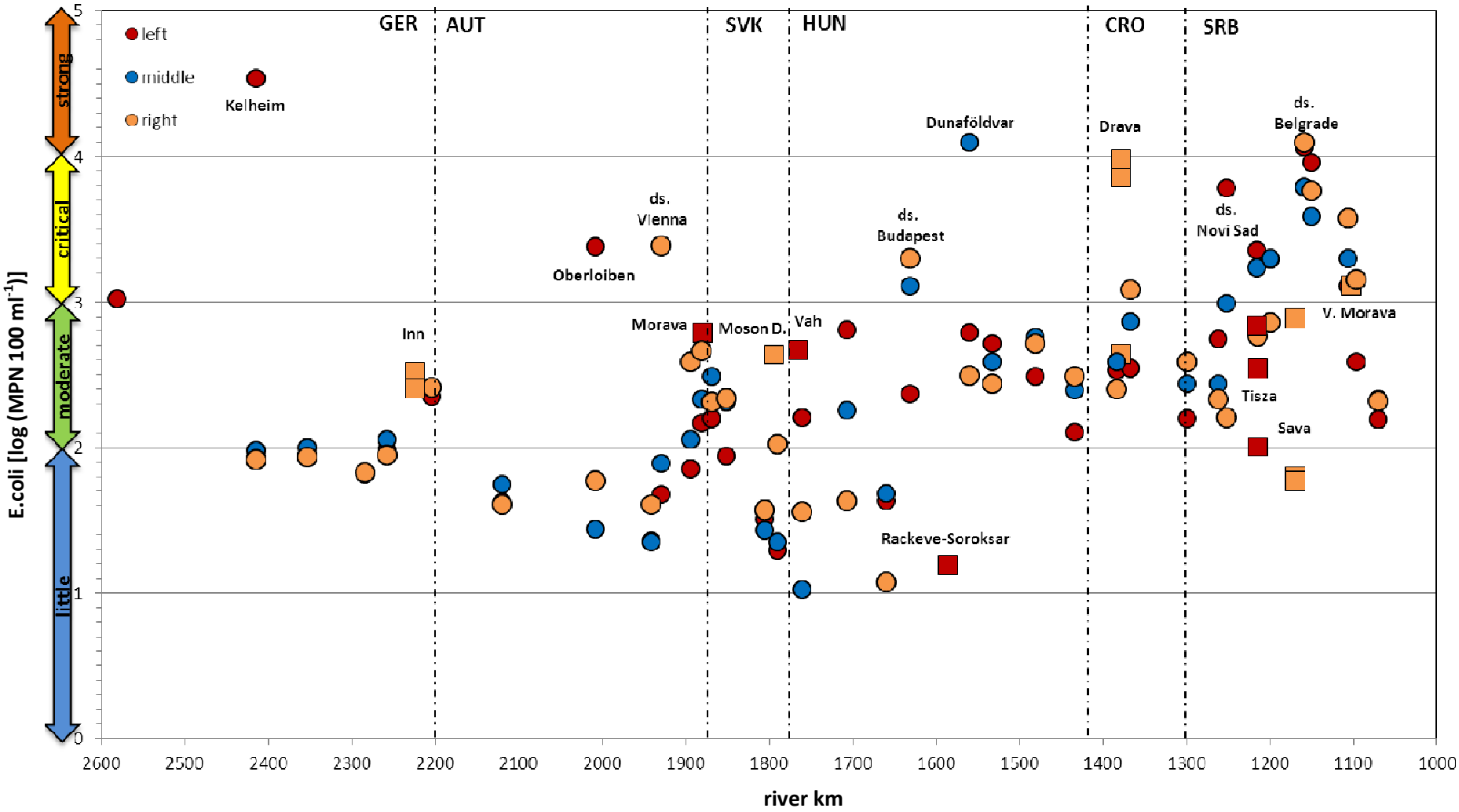

Figure 1:*Escherichia coli* concentrations along the Danube (circles) from river km 2581 (BöfingerHalde, Germany) to river km 1071 (BanatskaPalanka, Serbia) and selected tributaries (squares). Data were log – transformed: 1 = 10 *E.coli*per 100 ml, 2 = 100 *E.coli* per 100 ml, 3 = 1.000 *E.coli* per 100 ml, 4 = 10.000 *E.coli* per 100 ml, 5 = 100.000 *E.coli* per 100 ml. Samples were taken left (red), middle (blue) and right (orange) at all Danube stations except station 1 (BöfingerHalde) and at large tributaries (Inn, Drava, Tisza, Sava). Left side tributaries are marked with red, right side tributaries are marked with orange. Coloured arrows on the left side indicate the pollution status according to **Table 1**, from little (blue) to strong (orange) pollution.

As already mentioned in the first report, the classification of microbial-faecal pollution (**Table 1**) was based on based on the EU Bathing Water Directive and the EU Water Framework Directive as developed KIRSCHNER ET AL (2009). Again, it has to be considered that the data of bacterial indicators of faecal pollution generated during the Joint Danube Survey are single measurements. It can thus be seen 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.

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

Over all, Enterococci data corroborated the observed pollution pattern developed from *E.coli* data, as can be seen in **Figure 2**. Enterococci showed with a few exceptions (Kelheim left, Iza/szony left and right) lower concentrations than *E.coli* and exceeded EU-Bathing Water Directive limits of good water quality (400 Enterococci per 100 ml) twelve times (Oberloiben left, Kelheim left, after Budapest and Dunaföldvar, and especially in Serbia after Novi Sad and the stations after Belgrade). In addition to the Drava tributary, surprisingly sampling site Iza/Szony showed critical pollution levels, which was not reflected by the *E.coli* values. For quite a lot of samples, Enterococci concentrations were below detection limit (15 per 100 ml), among them Inn and Moson Danube.

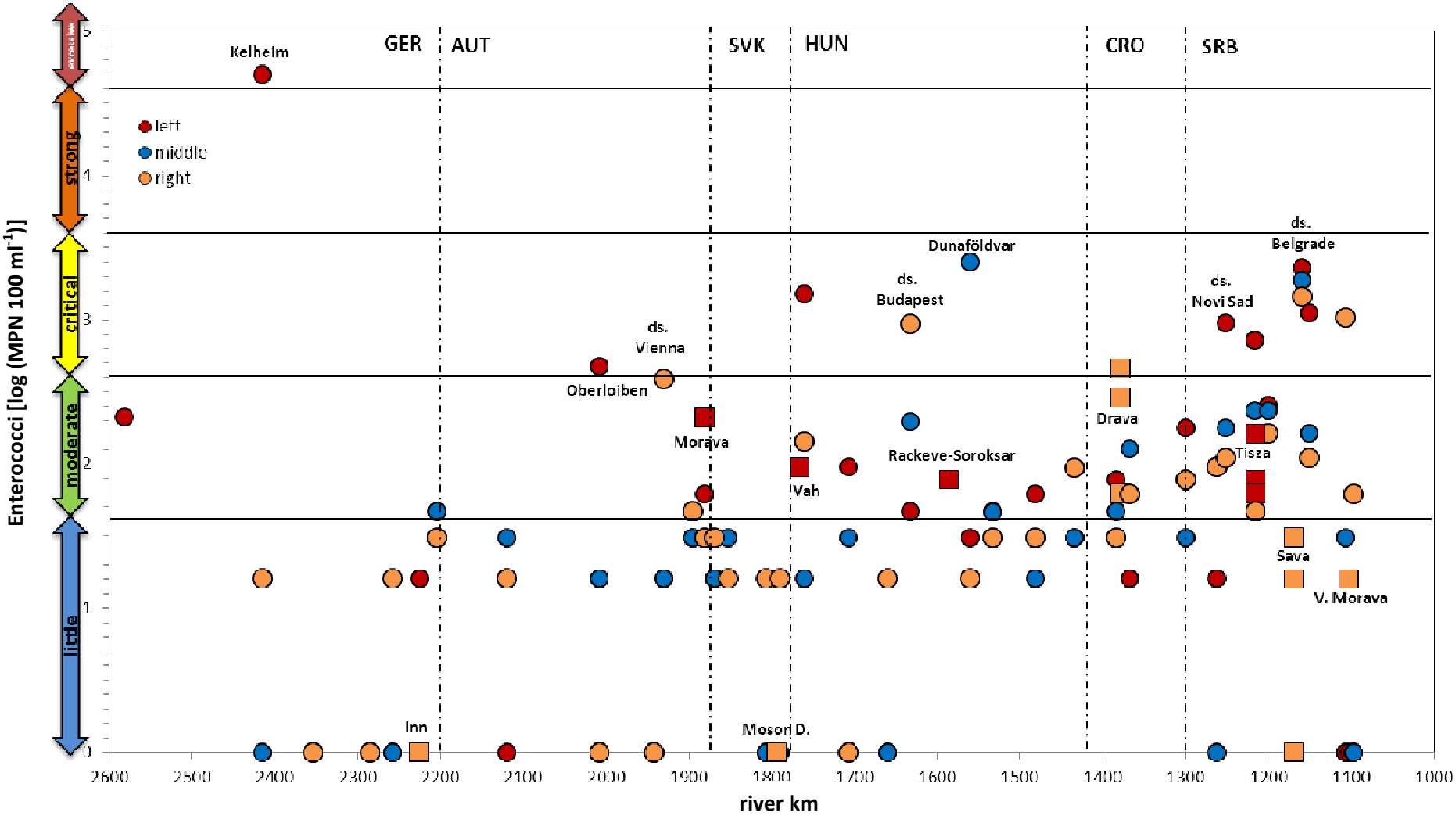

Figure 2: Enterococci concentrations along the Danube (circles) from river km 2581 (BöfingerHalde, Germany) to river km 1071 (BanatskaPalanka, Serbia) and selected tributaries (squares). Data were log – transformed: 1 = 10 Enterococci per 100 ml, 2 = 100 Enterococci per 100 ml, 3 = 1.000Enterococci per 100 ml, 4 = 10.000 Enterococci per 100 ml, 5 = 100.000 Enterococci per 100 ml. Samples were taken left (red), middle (blue) and right (orange) at all Danube stations except station 1 (BöfingerHalde) and at large tributaries (Inn, Drava, Tisza, Sava). Left side tributaries are marked with red, right side tributaries are marked with orange. Coloured arrows on the left side indicate the pollution status according to **Table 1**, from little (blue) to strong (orange) pollution.

Summing up, a generally good water quality was observed in Germany, Austria and Slovakia, with a few exceptions (Kelheim left, Oberloiben left and downstream Vienna right). In Hungary, microbial – faecal pollution levels were mostly moderate, but a strong increase could be observed after Budapest, exhibiting a > 70 km long wastewater plume until Dunaföldvar. The Drava (CRO) was the most polluted tributary so far with high critical pollution levels. Highest pollution in the Danube was observed in the Serbian stretch; mainly due to the influence of the large cities Novi Sad and Belgrade. Thereafter, concentrations of faecal indicators dropped significantly. 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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Literature

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