



The Project PlasticFreeDanube

Although **plastic** has many advantages, it has become a **serious environmental hazard** and has been recognized as **global problem**. Especially plastic waste in marine ecosystems has become a great environmental problem on regional and global levels. **Rivers** are recognized as **main vectors of pollution** although sources and pathways of plastic in the rivers and its environmental impacts remain widely unclear.

The project "**PlasticFreeDanube**" focuses on **macro plastic waste (> 5 mm) in and along the Danube river**, between Vienna (Austria) and the power plant in Gabčíkovo (Slovakia), and parts of its riparian area. The overall aim of the project is to establish a scientifically sound knowledge base as well as a methodological approach on plastic waste in and along the river in terms of entrance points, quantities, transport patterns, and environmental threats.

Sorting of screenings



At the beginning of the year 2019, 7 containers á 40 m³ of screenings at the hydropower plant Freudenuau were sorted, whereby the anthropogenic waste was picked out manually. Afterwards, the sorted waste with the overall mass of over 700kg was analysed according to the sampling protocol developed within the project.

After first optical analyses, the raw material could be classified as very diverse. On one side there were containers with mainly large pieces of dead wood and correspondingly with larger pieces of waste (bottles, sport and leisure articles), whereby on the other side there were especially two containers with high fraction of smaller biological material such as shrubs, branches and leaves where also many pieces of plastic foil were found.



In terms of material composition it can be stated that plastic waste belongs to the second largest category after wood waste ("processed wood", furniture, boards etc.) when considering mass fraction (in case of container nr. 7 even the largest category). By consideration of volume or number of pieces, plastic is clearly at the top.

From the previous results following statements can be made:

1. The composition of waste depends on the time of screen cleaning. The more material accumulates at the screen, the more probable is the retention of small debris and therefore also small pieces of trash (due to higher filter function).
2. There is a correlation between anthropogenic waste and natural debris in terms of material characteristics. According to the motto "like attracts like" small pieces of foil can be found between leaves whereas larger plastics usually stay between large debris.

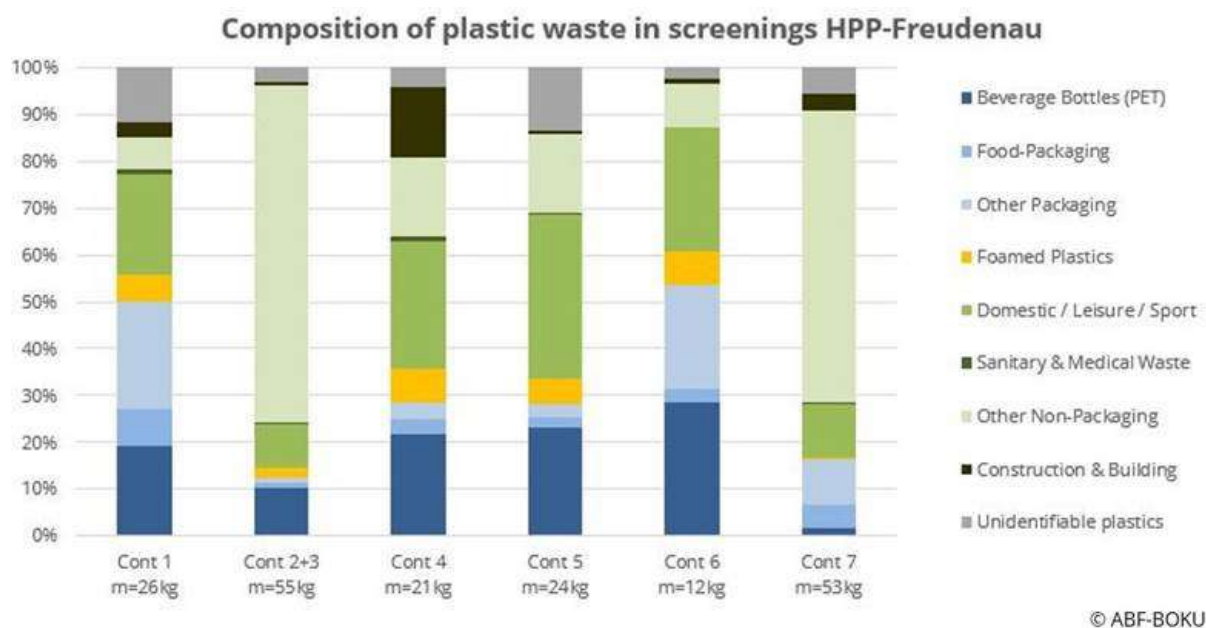


Figure 1: Composition of macroplastic waste in screenings (n=7) in hydropower plant Freudenau in Vienna

Accumulation zones – 3D hydrodynamic modelling

Within the framework of the project "PlasticFreeDanube" an attempt is made to characterize various macroplastic accumulation zones along the Danube east of Vienna on the basis of hydrodynamic-numerical modelling. Using a specially developed tool for particle tracking, the complexity of the flow fields near the surface has already been demonstrated with respect to hydrological conditions and bank structure. In addition, a

large-scale model was created with the software RSim-2D to analyse the bank near accumulation as well as in the flood plain.

In order to interpret the models the simulation results were linked with data from field surveys and statistical analysis of water level and discharge conditions. During monitoring activities in the field bank near accumulation areas were found along the shore line of frequently occurring water levels (Figure 2a). For this reason, hydrological series of Danube flows were used, with the most frequent water levels being determined for spring and summer or autumn and winter, depending on the hydrological regime (Figure 2b). With the water levels from the numerical simulations areas with a high accumulation potential could thus be determined and quantified (Figure 2c).

Further simulations carried out in the project deal with the influence of hydraulic structures and vegetation on the accumulation behaviour at different discharges. The knowledge gained should help to define targeted collection areas and to design artificial accumulation areas.

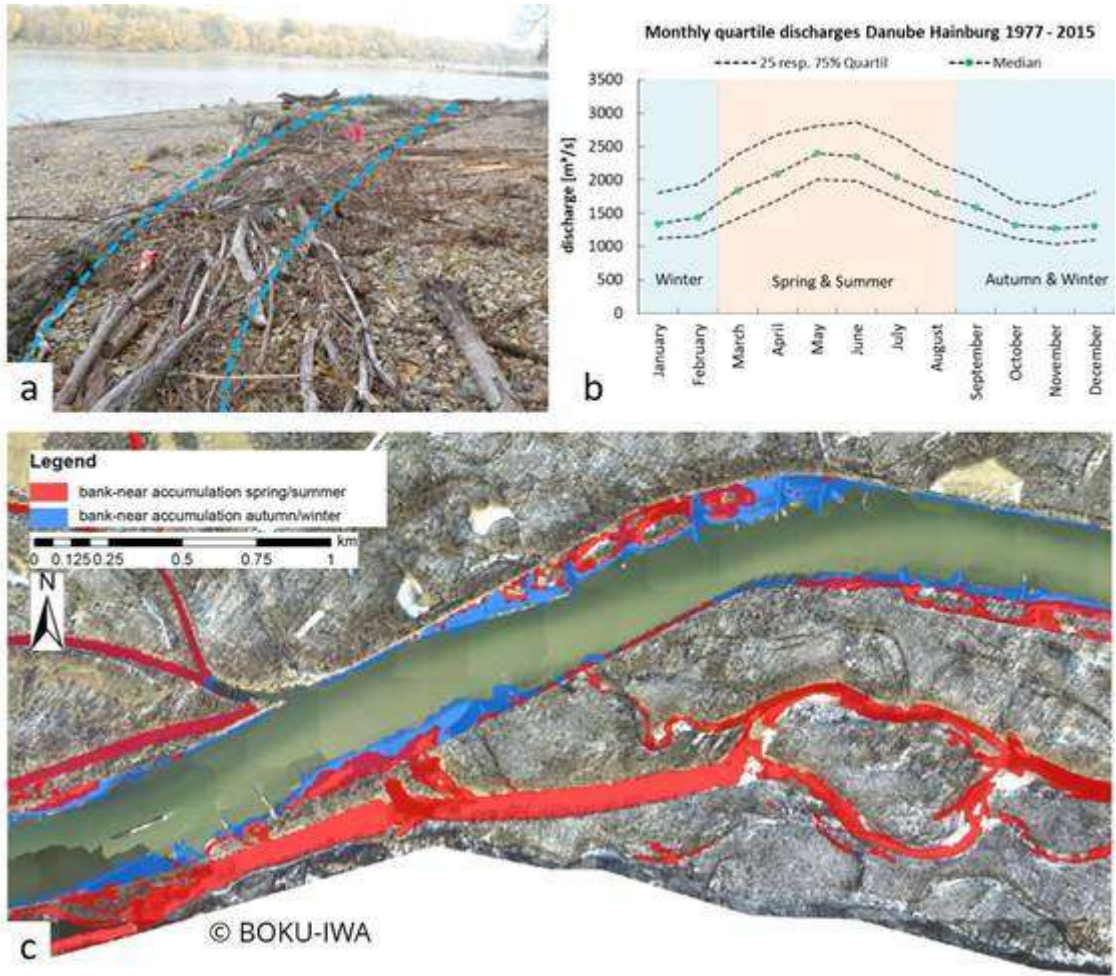


Figure 2: Characterization and quantification of bank near accumulation zones: Macroplastic along the bank of the Danube (a). Statistical analysis of flow data (b). Delineation of potential bank near accumulation zones based on the model results (c).

Analysis of plastic waste concerning hazardous materials

Our leaching experiment was done in order to evaluate the possible hazardous materials leaching from the plastic waste. Samples of plastic waste found along the Danube were placed into glass bottles containing 80 ml of ultrapure water and left there for approximately one month to shake in at 560 rotations per minute (r/min). Since the quite high rotation generates some shear force by vortices, we examined also the generation of microplastics. For the evaluation of microplastic generation micro-FTIR and optical microscopy was used. The decanted water was then analysed by gas chromatography coupled with mass spectrometry in order to detect the leached organic substances into the water. The concentrations of detected organic substances were well below some hazardous limits. We did a chemical analysis concerning metals as well and in the case of PET bottles we detected an elevated concentration of antimony of approximately 200 $\mu\text{g/l}$, whereby the limit for drinking water is 5 $\mu\text{g/l}$.



Learn more about our project in the project brochure



To learn more about the PlasticFreeDanube project visit our website www.plasticfreedanube.eu or have a look at our brand new project brochure. It briefly summarises the project objectives, the planned project output, the project area as well as the pollution sources. The brochure is available in Slovak/German language as well as in English and can be downloaded at our project website.

Download:

- [Project Brochure Slovak/German](#)
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Contact:

BOKU – University of Natural Resources and Life Sciences, Vienna
Gudrun Obersteiner
Muthgasse 107/III
1190 Vienna, Austria
info@plasticfreedanube.eu

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Responsible for the content: University of Natural Resources and Life Sciences Vienna, Gregor-Mendel-Strasse 33, 1180 Vienna, Tel. (+43-1) 47654-0, abf@boku.ac.at, <http://www.boku.ac.at>, UID: ATU16285008