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D2.3 Report on Plastic Pirates' data

Title: Report on Plastic Pirates' data
Date: 30/11/2023
Confidentiality: Public

Executive summary

This report primarily focuses on delivering a quantitative assessment, encompassing several metrics:

- **Processed Macroplastic Data Sets**: The report outlines the number of macroplastic data sets that have been successfully uploaded and processed.
- **FTIR Spectroscopy**: It details the quantity of FTIR spectroscopies conducted, shedding light on the scientific analysis performed to identify various materials.
- **Results Analysis**: It provides short and concise reports regarding the analysis of results derived from multiple facets. These include assessments of litter quantities, the composition of litter along riversides, litter accumulation, the identification of hazardous materials on riverbanks, disposables present on riversides, floating litter within the river, the presence of large microplastics (> 1mm), and the potential sources of litter along riversides.

This executive summary offers a glimpse into the forthcoming deliverable, highlighting the depth and breadth of data analysis carried out to gain valuable insights into plastic pollution in our waterways.

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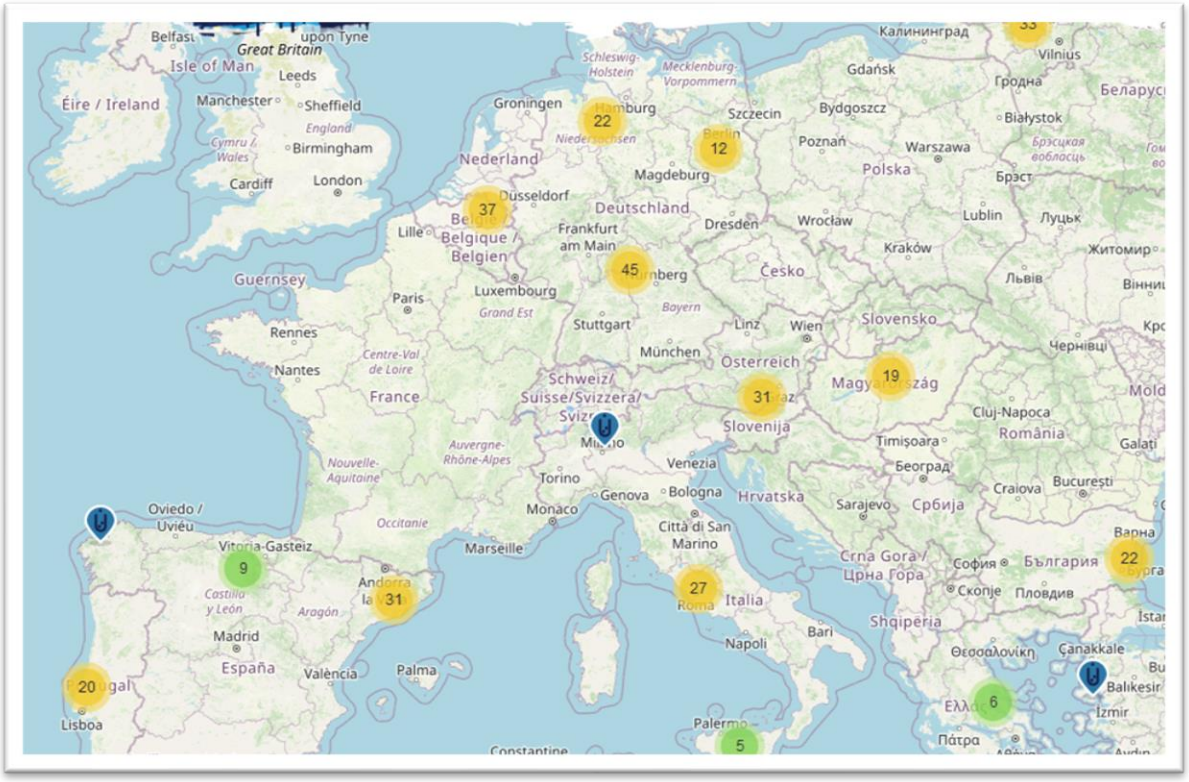
1. Introduction

Plastic Pirates – Go Europe! is a European-wide citizen science project dedicated to combatting plastic waste pollution in the aquatic and marine environment. 10-16-year-old Europeans go to a river, waterway or coastal area to gather scientifically valuable data on waste pollution, particularly macro- and microplastics. Researchers across Europe validate and process the data to contribute to excellence science and help monitor EU policy objectives like the Zero Pollution Action Plan or the Single- Use Plastic Directive (SUPs).

The Coordination and Support Action "PlasticPiratesEU" is upscaling the initiative by establishing pilot projects across Europe under the Mission Restore our Oceans and Waters by 2030 from June 2022 – November 2024. This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 10108882.

Essential part of the initiative are (plastic)waste samplings at rivers, waterways or coastal areas across Europe. The young Europeans conducting a sampling divide into four groups. *Group A* explores the waste on the riverbank in terms of quantities and variety. *Group B* categorizes the waste found to determine how many and what kind of waste items are found on the riverbank. *Group C* investigates both larger items as well as microplastic in the river with a manta net. Finally, *Group D* documents all findings by taking pictures that are used for verification of the data by scientists.

Two sampling campaigns are held each year. One in spring, the other is held autumn. The exact duration of each sampling campaign varies across participating countries depending on weather conditions and school vacations. In September 2022, with the start of the autumn campaign, a total of *nine* European countries were participating in the citizen science initiative with school children conducting samplings at European rivers and waterways until February 2023.



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The purpose of this deliverable is to give:

1. An overview of how the data gathered by school children and youth groups across Europe is being processed and verified after collection.
2. Shed light on how verified data undergoes additional quality checks and a consolidation process.
3. A concise report on *preliminary* results derived from the data uploaded to the Plastic Pirates' database:
    a. Total number of samples
    b. Total number of verified samples and discarded samples
    c. Litter quantities along riversides
    d. Composition of litter on the riverside; Kgs of waste found
    e. Kgs of plastic waste found
    f. Identification of potential sources of litter along riversides
    g. FITR analysis

***Note**: Be aware that this report is being published while scientific analysis is still ongoing. All data results are preliminary and may be updated at a later stage.*

3. Data Processing

The Plastic Pirates data verification process is a structured approach undertaken to ensure the accuracy, reliability, and integrity of the citizen science data collected during campaigns. The following outline summarizes the key steps involved, ranging from confirming the sampling attempts to detailed verifications of metadata and specific data collections by different groups. Each step contributes to a comprehensive evaluation, fostering transparency and quality assurance in the Plastic Pirates project.

a) Sampling Attempted:

In this initial step, the focus is on discerning whether the participating group made a genuine attempt at data collection (1), had to cancel their mission (0), or if the status is unknown (?). If there was a cancellation, a brief comment is appended to provide context, such as reasons for cancellation, be it due to illness, adverse weather conditions, or logistical challenges.

b) Verification of Metadata:

The verification process revolves around documenting essential information for each dataset. If critical details like the sampling day or coordinates are missing, the dataset is flagged as disqualified. This step ensures that the metadata, such as sampling date and location, is accurate, contributing to the overall reliability of the dataset.

c) Verification of Riverside Litter Data (Group A):

For Group A's dataset, the focus is on confirming their active participation and excluding datasets with method deviations, illegible data, or missing photos. A meticulous examination is conducted to match photos to the

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data for each sampled station. This thorough verification process ensures the reliability and accuracy of the riverside litter data collected by Group A.

d) Verification of Riverside Litter Data (Group B):

Similar to Group A, Group B's dataset undergoes verification to confirm their active participation and exclude datasets with method deviations or illegible data. The assessment includes evaluating the percentage of misclassifications, providing insights into the accuracy of the data. Documenting the accepted data for Group B ensures transparency in the verification process.

e) Verification of Riverside Litter Data (Group D Reporter Team):

In this step, the active participation of Group D is confirmed, and the dataset is checked for source matching with other groups. Datasets are disqualified if sources do not align, and data reported by schoolchildren are recorded. Any problems reported by the group that could impact data quality are also addressed, contributing to a comprehensive verification process.

f) Verification of Riverside Litter Data (Additional Group Investigating Sediments):

This documentation step assesses whether the additional group attempted data collection and includes any relevant comments. While their data might not be analysed in detail, acknowledging their participation is integral to maintaining transparency in the overall verification process.

g) Verification of Floating Litter Data (Group C Floating Macroplastics):

For Group C's floating macroplastics data, verification involves confirming their active involvement and disqualifying datasets for various reasons such as unquantified litter or insufficient observation time. Providing information associated with this group ensures clarity and completeness in reporting their contribution.

h) Verification of Floating Litter Data (Group C Floating Microplastics):

This detailed step includes registering and verifying received samples, disqualifying samples with specific issues, conducting visual sorting and FTIR measurements for plastic identification. The meticulous process ensures the reliability of the floating microplastics data collected by Group C.

i) Verification of Floating Litter Data (Group C Flow Velocity):

The final step involves validating the flow velocity data based on specified criteria. Ensuring that measurements fall within a defined range contributes to the reliability of data used for estimating microplastics per volume unit for the entire study area. This step helps maintain consistency in the analysis of flow velocity data across the dataset.

j) Post – Data Verification and Quality Assurance

After local partners have verified and submitted their datasets, are gathered and compared to identify data gaps, discrepancies and systematic errors. Differences in the reported data and data validation are addressed. Based on the data requirements identified, each member institute is asked to adapt their datasets. Instructions and assistance are provided to ensure they recognise the data requirements and address the issues. Updated datasets from each member institute are received and reviewed to ensure data completeness and accuracy. A series of data quality checks are performed to verify if certain parameters' values fall within a defined common range. For example, the evaluation of river flow velocities for consistency, checking measurements related to the stick's travel time, or distance, and cross-validating data from different groups. When there are questions about the data, data providers are contacted to clarify these. If these cannot be clarified, exceptionally some data points may have to be excluded from the consolidated dataset.

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After this quality assurance check, a mapping of the plastic categories used with the standard reference lists (OSPAR 2010, EMODnet) is done. A standard data format is defined following existing international standards (such as marine litter data formats from EMODnet) to obtain a more user-friendly format (e.g., to be used by researchers and policy makers) and to facilitate possible future integration in an international database. Individual datasets are merged into this format. The consolidated dataset undergoes a process of formal concretisation with reduced background noise (i.e., inaccuracies) and a clear formatting. Final data quality checks are performed in the consolidated dataset to verify if international open standards are met. A script in R will be developed and run on the dataset to check the following:

- Mandatory fields are present and filled out
- Dates and/or time follow the same standard format (ISO 8601 compliant)
- Coordinates fall within the bounding box sampled and are expressed in decimal degrees, using the spatial reference system EPSG:4326 (WGS84)
- Parameter values fall within an established range
- Parameter units use International System of Units (SI) and are always filled out
- Litter categories are mapped to the Beach litter reference list from OSPAR
- Required micro-litter data is sufficient for EMODnet data submission. For example, controlled vocabularies from the NERC Vocabulary Server, to define if terms such as polymer types or particle size ranges are used.

This script will be open source and its long-term preservation is secured by using the online GitHub repository for further reusability. The purpose is to create a data processing workflow that can be adopted in the future as well.

***Note**: For an even more detailed description of the Plastic Pirates protocol, method and data processing, please also see Deliverable 3.1 "Plastic Pirates – Go Europe! common and harmonized standards to data sampling, processing, analysis and storage".*

4. (Preliminary) Quantitative Assessment

This preliminary summary of the quantitative assessment provides a glimpse into the initial findings from Plastic Pirates' expansive initiative across *nine* European countries.

Time period of samplings: September 2022 – January 2023

Countries: Austria, Belgium, Bulgaria, Germany, Greece, Hungary, Italy, Lithuania, Portugal, Slovenia, Spain

The data spans various indicators, offering insights into litter quantities, composition along riversides, kilograms of waste, and the identification of potential sources. While the results are in a preliminary stage and undergoing validation, they already highlight significant variations in plastic litter items, single-use plastics, and the weights of litter across participating countries. The assessment also offers a visual

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representation of reported sources of litter, emphasizing the diverse nature of this citizen science initiative's impact.

***Note 1**: Please note that data refer to preliminary results, and that datasets are currently still going through a systematized validation process.*
***Note 2**: German data was not yet available at the time of this preliminary data overview.*
***Note 3**: Please note that data do not refer only to sampling alongside riverbanks from inland waters, but also, as in the case of Bulgaria, to coastal waters.*

262 samples uploaded to the Plastic Pirates database

Riverbanks from nine European countries were screened for litter bigger than 2,5 cm. In the case of the sampling that took place in Bulgaria, the locations were coastal beaches instead. The preliminary data indicates that, on average, the highest number of plastic litter items per sampling event was observed by schools and students in Portugal, with approximately 164 plastic litter items per sampling, followed by Hungary and Slovenia (Fig. 1). Different school groups screened litter on average from 50 m to 200 m along riverbanks. The highest relative ratio of single-use plastics (SUPs) was observed in Hungary, Bulgaria and Spain (Fig. 1). SUPs were above 50% of the plastic litter items observations per sampling in Slovenia, Lithuania, Spain, Portugal, Greece, Bulgaria and Belgium (Fig. 1). Future analysis will include an overview of the sampling locations and proximity to industries, urban areas and volume of pluviosity during the sampling season.

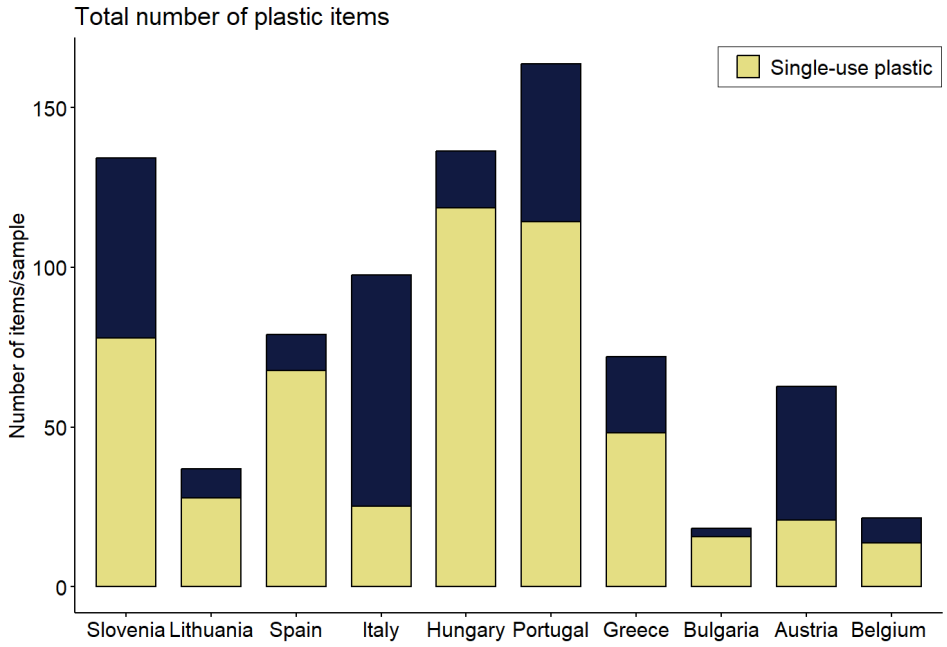


Figure 1: Number of total plastic items per sample for each participating country. Single-use plastic items are shown as a proportion of the total number of plastic items observed. Please note that data refer to preliminary results.

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The average weight of litter and plastic litter per sampling event for each participating country is shown in figure 2. According to these preliminary data, the total weight of all litter was observed to be highest in Hungary and Belgium (Fig. 2). For all countries, the relative weight of plastic litter was below 50% of the total litter weight observed in a sample.

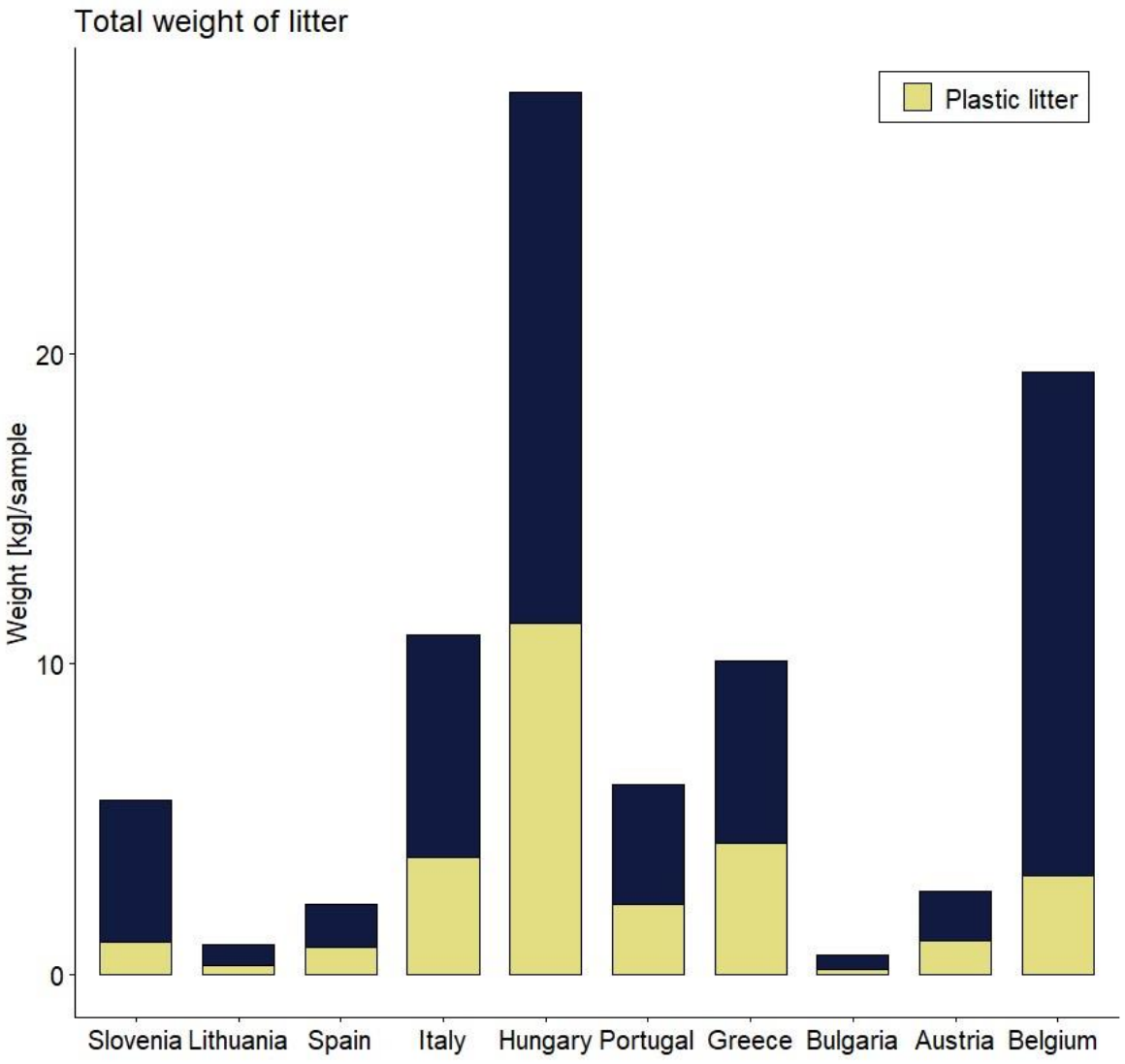


Figure 2: Weight of the total amount of litter (in kilograms) per sample for each participating country. The weight of the plastic litter is shown as a proportion of the total litter weight. Please note that data refer to preliminary results.

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For each participating country, the number of cigarette butts found per sample along the riversides (beaches in the case of Bulgaria) can be seen in figure 3. These preliminary data indicate that, on average, the maximum number of cigarette butts observed per sample is 31, in Austria followed by Bulgaria, and the minimum number is 1 (in Italy) (Fig. 3). For most countries, between ten and twenty cigarette butts per sampling event were found.

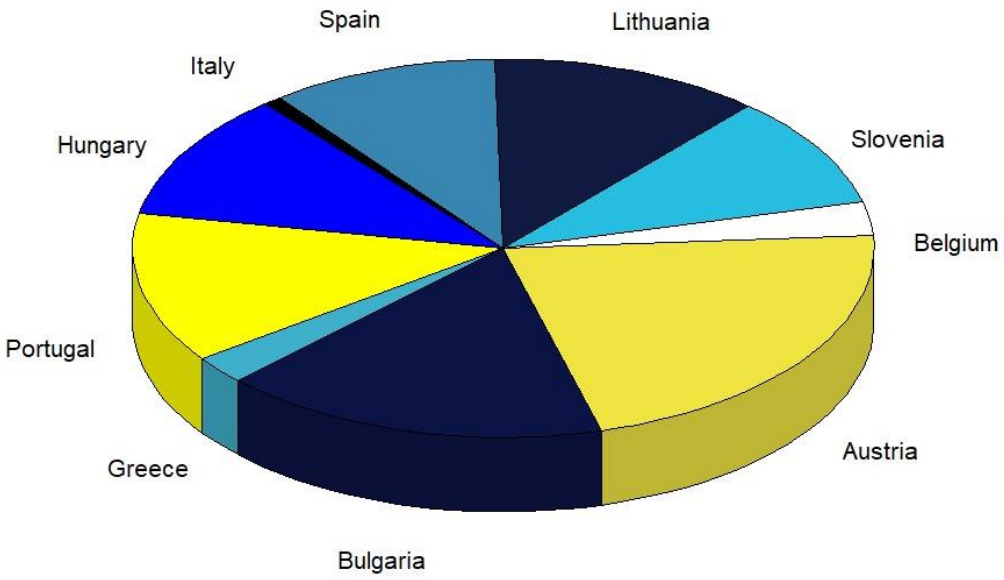


Figure 3: Number of cigarette butts found per sample for each participating country. Please note that data refer to preliminary results.

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A visual representation of the reported (potential) sources of litter indicated in the Plastic Pirates datasets is shown in figure 4. Sources that were most frequently mentioned amongst the participating countries are visitors and residents, followed by agriculture and fly-tippers.



Figure 4: Report of potential sources of litter based on visual inspections by the local observers. The prevalence of the sources mentioned in all datasets (in total) is represented by the size of the words, with larger fonts representing the sources that were mentioned with a higher frequency among the participating countries.

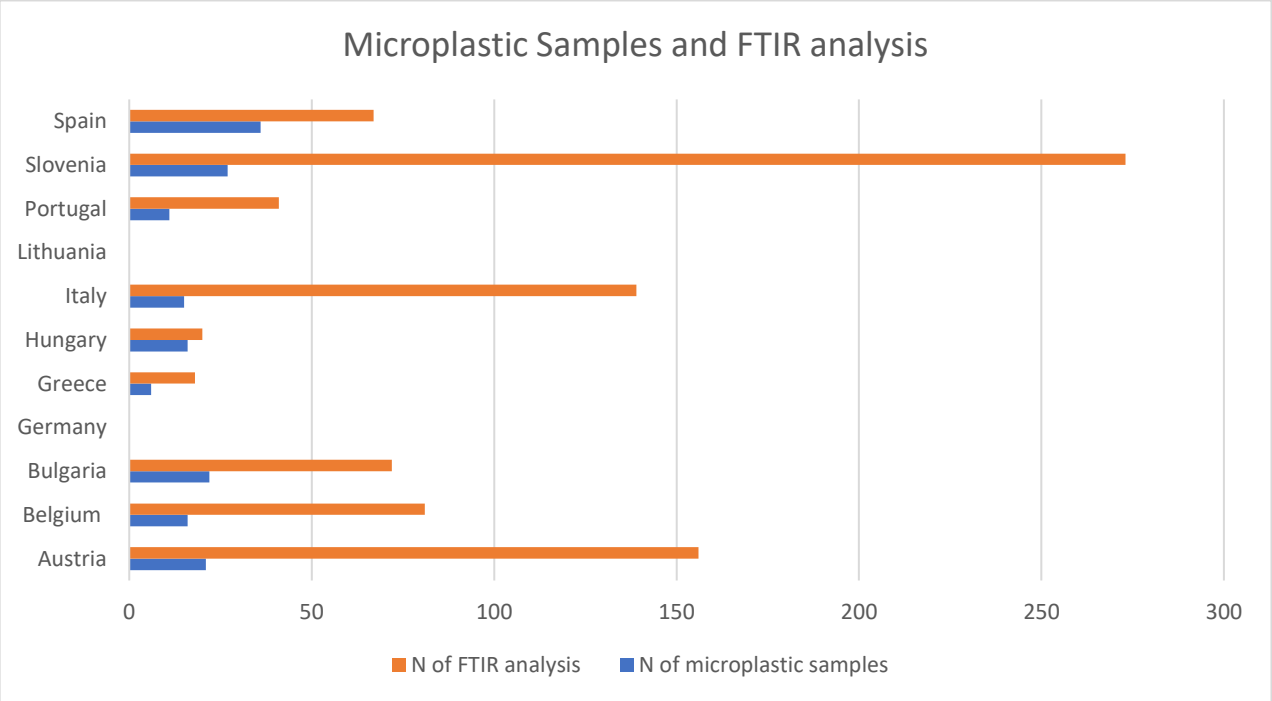
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170 microplastic samples

Overall, in the first EU campaign of Plastic Pirates, **170 microplastic samples were collected from 203 riverside samplings conducted in 9 countries** (Lithuania and Germany are excluded as they did not provide microplastic data). These samples were subsequently sent to scientific institutes for analysis. They underwent Fourier Transform Infrared Spectroscopy (FTIR) to determine particle material. In total, **867 FTIR analyses were conducted**, which encompassed both positive values (plastic polymers identified) and negative values (other types of organic and inorganic material). However, the number of positive versus negative FTIR analyses varied among countries and was contingent on the expertise of the researchers involved. Generally, researchers more experienced with plastic and riverine samples tended to conduct fewer FTIR analyses as they could more effectively pre-sort particles from the sample.

Within each FTIR analysis reported, the particles were analysed 1 to 3 times (from different surfaces), and multiple scans were conducted to gather data about the sample. The number of scans per individual FTIR analysis can vary based on factors such as the instrument settings, the nature of the sample, and the time the researcher allocates for analysis. For example, in Slovenia, if the output score results are higher than 85%, the number of scans was set at a minimum of 4 scans, while for particles that do not show a clear pattern, the number of scans set is increased to 16 or 32. Spain used 16 scans, and Italy and Austria used 32 scans for each analysis.



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6. Data Storage and Sharing

Data storing and sharing will follow current standardised international procedures and will follow the FAIR principles (Wilkinson, 2016). Data are first stored on a shared cloud. Later, the datasets of each country are stored on the Marine Data Archive (MDA), a secured data repository managed by the VLIZ Marine Data Centre of the Flanders Marine Institute (VLIZ, Belgium), and available for all Plastic Pirates member institutes. The consolidated dataset will be archived and made openly accessible in an online repository (MDA or Zenodo). A Digital Object Identifier (DOI) will be issued, enabling proper citation and tracking. To further improve the findability of the dataset, a metadata record will be created in IMIS. This record will also be available in a machine-readable format (e.g., XML, JSON). The individual datasets of each country will also be findable through the Integrated Marine Information System (IMIS), via a metadata record with information on how to request these. Future users of the data might be interested in the raw data because some extra information could be available in these individual datasets and it illustrates how the data were collected and, together with the data consolidation script, how the final dataset was composed. The record in IMIS will be linked to the institute's affiliations and ORCiDs of the researchers involved in the data, to the script used for data consolidation on GitHub, and to related datasets and publications to ensure traceability.

Currently and to the best of our knowledge, we are unaware of an international database that fits freshwater plastic-litter data. Hence, the consolidated dataset will be submitted to EMODnet Data Ingestion. The dataset in EMODnet Data Ingestion will be assessed to see in which thematic portal it fits. EMODnet Chemistry is the thematic lot that aggregates litter data, but it only deals with marine data. Therefore, subsets of the dataset that were collected in a marine environment may be eligible for EMODnet Chemistry. The DOI of the dataset will be stated in the metadata record in the catalogue from the EMODnet Central Portal. Potential data repositories or databases for freshwater litter data will be explored.

Data privacy and security lies first with the Plastic Pirates member institutes and coordinators, and it is their responsibility for backing-up and to provide recovery of the data. Once the data are stored in a repository, that responsibility lies with the data repository. Both MDA and Zenodo provide a secure environment for long -term archiving and their policies are clearly described on their website. The license, accompanying the data and defining the conditions under which the data can be (re)used, will be an open license that enables the free use of the data by anyone (CC0, as indicated in the DMP and Grant Agreement). This meets the requirements of Horizon Europe regarding open data. A specified embargo period during data publication is possible if requested by the Plastic Pirates project coordinators and participating members. Any personal data or data that can only be shared under restricted access conditions because of legal or contractual reasons, legitimate interests or other constraints stated in the grant agreement will be left out of the final dataset that is being openly published and shared. These data can also be securely stored under restricted access on MDA.

MDA: Online secured repository that can be used as a closed or open access repository by individuals, consortia, working groups, projects and institutes to archive data files. The development, backup and maintenance of the MDA is an institutional activity of VLIZ. It ensures long-term preservation of the data. The VLIZ Marine Data Centre (VMDC) is accredited by the ISC (International Science Council) as a World Data Center since 2011 and by IODE (International Oceanographic Data and Information Exchange) as a National Oceanographic Data Centre (NODC) for Belgium since 2019.

IMIS: Information system, developed and maintained by VLIZ, that provides and links metadata information on people, institutes, projects, datasets, publications and events related to marine, estuarine and coastal topics. IMIS provides a direct link to the dataset or publication or gives more information on how to access data in

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case of restricted access. Via this system, datasets can be made findable and accessible in the MarineInfo catalogue. Also, a DOI service for data publication is coupled to IMIS (via an agreement with DataCite).

7. Impact and Implications

The data and findings from the Plastic Pirates – Go Europe! initiative significantly contribute to scientific understandings of plastic pollution in aquatic and marine environments. By engaging 10-16-year-olds in citizen science, the project collects valuable macro- and microplastic data, offering researchers across Europe insights into waste pollution. The initiative is aligned with EU policy objectives, including the Zero Pollution Action Plan and the Single-Use Plastic Directive. The detailed data processing and verification outlined in this deliverable ensure the accuracy and reliability of the citizen science data, fostering transparency and quality assurance. The preliminary quantitative assessment reveals variations in plastic litter items, single-use plastics, and litter weights across nine European countries, providing essential information for further scientific analysis and policy considerations.

- Discussion of how the processed data contributes to scientific understanding.
- Implications for policy objectives and environmental awareness.

8. Conclusion

The Plastic Pirates – Go Europe! initiative is a successful citizen science project, engaging young participants aged 10-16 across Europe in the collection of valuable data on plastic waste pollution. With a focus on contributing to scientific excellence and aligning with EU policy objectives, the initiative involves four distinct groups undertaking samplings to comprehensively study litter quantities, categorization, investigations into larger items and microplastics, and meticulous documentation. Supported by the Coordination and Support Action "PlasticPiratesEU," the initiative has upscaled its efforts, implementing pilot projects across Europe under the Mission Restore our Oceans and Waters by 2030, with funding from the European Union's Horizon Europe program.

This report offers a transparent overview of the structured data processing and verification procedures employed by the Plastic Pirates initiative. The meticulous steps, including sampling attempts, metadata verification, and detailed assessments of riverside and floating litter data, ensure the accuracy, reliability, and integrity of the citizen science data. Additionally, the preliminary quantitative assessment provides a glimpse into the initiative's impact, showcasing variations in plastic litter items, single-use plastics, and litter weights across participating countries. Visual representations and cautionary notes about the ongoing scientific analysis underscore the initiative's commitment to delivering high-quality, reliable, and impactful results in the ongoing fight against plastic pollution.