**PN23300102 – Development and technology for assessing, monitoring and controlling of plastic objects and particles pollution in the coastal and shelf area of the Black Sea**

**Phase 1: Assessment of macro-litter and micro-plastic pollution in the coastal area and the internal shelf during the spring period (deadline: 14.06.2023)**

**Phase 1 Activities:**

* ***Synthesis of scientific relevant* *data to the area and field of study, establishment of the monitoring program;***

For the scientific documentation, various materials (articles, books and book chapters,

internal reports, etc.) were accessed to be used as information on testing methodologies, sample testing preparation, as well as quantitative and qualitative analysis of macro- and microplastics.

* ***Organizing and preparing the field activities and the analytical methods;***

In this activity, the institute's endowment was prepared and the equipment, the necessary materials and supplies were purchased.

* ***Carrying out field activities in the coastal area and on the internal shelf;***

The field activity (19 -26 April 2023) represented the initiation of the monitoring program. This included: 1. delimitation of the beaches perimeters (5m2) for macro plastics assessment. 2. collection of beach sediment samples from 3 micro areal for each location: a. swash zone, b. storm waves limitation, and c. vegetation line; 3. collection of sediment samples from the sea shelf; 4. sampling of water from the sea surface using a Neuston net.

* ***Sample analysis in the laboratory to obtain quantitative and qualitative data;***

For the complex analysis of microplastics, it is necessary to go through the following stages of samples preparation in the laboratory (Fig. 1): 1. drying and weighing the sediment; water samples require sieve refiltration; 2. gravitational separation of plastics from sediment 3. digestion of samples for the dissolution of the organic matter and neutralization; 4. vacuum filtration with the Buchner system.

* ***Data interpretation and integration into the monitoring system and the phase report implementation.***

The visual investigation process, which was carried out after the extraction of microplastics from sediment, water and fauna samples, involves the identification, quantification and characterization of plastic particles on the surface of the filter membranes resulting from the analytical procedures.

**Phase 1 Results:**

* **Defining the degree of pollution with macro-waste and microplastic particles in the beach sediments sampled from different locations: Sulina, Sfântul Gheorghe, Mamaia Sud, Constanța (Modern Beach), Eforie Nord, Neptun, Mangalia and Vama Veche.**

Plastic pollution in beach sediments was identified for each studied area in the following concentrations: Sf. Gheorghe – perimeter 1: 6 objects/5m2; perimeter 2: 14 objects/5m2; Sulina: perimeter 1: 4 objects/5m2; perimeter 2: 12 objects/5m2; central Mamaia: 1 object/5m2; south Mamaia: 2 objects / 5m2; Constanta Modern Beach: 2 objects/ 5m2; Eforie Nord: 0,5 objects/5m2; Neptun: 1 object/5m2; Mangalia: 43 objects/5m2; Vama Veche: 8 objects/5m2.

* **Assessment of the abundance and distribution of microplastic particles in the surface water of the Black Sea from the proposed locations to study (Sulina, Saint George, Mamaia South, Constanta (Modern Beach) and Eforie Nord).**

Following the processing of samples taken from the sea water surface, an average concentration of 0.58 particles per m3 of water was identified. Low concentrations were recorded in the area adjacent to Sulina, Constanta and Mamaia (<0.5 MPs /m3), average concentrations were identified in the adjacent area of Eforie and Sf. Gheorghe (0,5 – 1 MPs / m3), as well as high concentrations (>1 MPs / m3).

AICI VINE FIGURA 1, PE CARE TE ROG SĂ MI-O TRIMIȚI PRIN E-MAIL, CU TOT CU TRADUCEREA EXPLICAȚIEI FOTO.

* **Investigating the degree of pollution with microplastic particles from Pontic Shad individuals (Alosa immaculata) by analyzing the digestive tract and internal organs, as well as the gills of the fish.**

In the case of fauna samples, 2 sets of analyzes were carried out: microplastics from the digestive tract and microplastics from the gills of the Pontic Shad 10 individuals. In the internal organs, an average concentration of 6 particles per individual (between 0 and 17 particles), represented exclusively by fibers, while the gills were evaluated at an average concentration of 10 particles per individual (between 4 and 15 particles).

**Phase 1 Dissemination:**

Baboș, T., Dobre, O., Pop, C. I., Pojar, I., Lazăr, C. (2023). “Microplastic characterization in Romanian coastal waters, Western Black Sea”. GeoEcoMarina 29.

**Phase 2: Development of theoretical models of technological equipment (deadline: 10.08.2023)**

**Phase 2 Activities:**

* **Consulting data from patents, consulting patents on similar equipment;**

În vederea documentării științifice pentru realizarea CHIRP-SSD, s-au accesat diverse materiale, urmând a fi utilizate informații privind modificarea și dedicarea unui sistem complex, integrat, compus din 2 sonare de tip CHIRP, a unui GPS și a unui ADP.

For the scientific documentation for CHIRP-SSD, various materials have been accessed, the information on the modification and dedication of a complex, integrated, integrated system comprising of 2 CHIRP sonars, a GPS and an ADP, to be used.

Privind dezvoltarea și tehnologizarea unui sistem complex de colectare probe și măsurători în coloana de apă s-a determinat necesitatea utilizării unei platforme nautice care să aibe ca specificații de bază staționarea la punct fix și cu capacitatea menținerii echipamentelor de citire (ex. CTD, ADP) la adâncimi variabile prestabilite.

Regarding the development and technology of a complex system for collecting samples and measurements in the water column, it was determined the need to use a nautical platform that has as basic specification the stationary at fix point and having the ability to maintain the reading equipment (eg. CTD, ADP) at predetermined variables depths.

NU SUNT DELOC SIGURĂ PE ACURATEȚEA TRADUCERII. VERIFICĂ, TE ROG, CU MARE ATENȚIE.

* **Modifying and integrating the components for the realization of theoretical models;**

Through the study carried out on the operation and efficiency of existing technologies for the development of CHIRP-SSD, it was concluded that there is the need to modify the basic equipment, in order to develop a special equipment designed (specialized) to identify the waste from the water-sediment interface from the coastal and shelf area of ​​the sea.

* **Identifying the material needs for equipment optimization;**

Following the evaluation of the specifications of the equipment on the market for CHIRP-SSD, a qualitative (resolution) and quantitative (working speed) comparison had been made aiming to improve the operating model and to update the working methodology.

* **Completion of some theoretical models of equipment and realization of the phase report;**

The theoretical model of CHIRP-SSD used in shallow water environments has the advantage of identifying the physical characteristics of macro plastics located in the water column and on the superficial layer of sediment. Due to the need of practical study of operation, it is possible to increase the interconnection of several types of sonar. Repeated field testing of the equipment is, thus, necessary.

The nautical platform proposes a motion sensor system to counteract the action of the disturbing forces. The electricity supply is provided by photovoltaic panels, a generator

wind and batteries. This platform is designed to provide a stable infrastructure for the assembly of scientific instruments, including a winch for submerging a thread system for collecting microplastics from the water column. Based on the documentation and the developed theoretical model a patent application was filed, titled Nautical Platform and Stabilization Method.

**Phase 2 Results:**

* **The theoretical model of Equipment and method of collection of microplastics from dry beach sediments presents a patented concept (135310 / 28.04.2023), that is functional and framed as an experimental model, technology and solution for the automatic collection of macro-waste and microplastics, the large objects being separated from the sediment by triage and sieving methods and the microplastics being recovered by electrostatic separation.**
* **Testing and patenting (134207 / 28.07.2023) of a theoretical model, but also of a prototype equipment and related method, is presented as a module part of Equipment and method of microplastics collection from the dry beach sediments.** **This module, called Electrostatic Separator for Microplastics, refers to equipment for collecting microplastics from dry sediments, with the possibility of recovering the particle concentrate in order to determine the pollution degree.**

**Phase 2 Dissemination:**

Given the results of Stage 2 of the project, the dissemination consisted of the two patents granted in 2023 (Fig. 2) on the practical way of accumulating microplastics from samples of dry beach sediment (sand). Both equipment, which were filed for patent, were declared inventions by OSIM (State Office for Inventions and Trademarks) during 2023 (Fig. 2), as a result of the research activity in the field of microplastic pollution.

**Phase 2 Equipment:**

* Marine GPS with inReach functions GPSMAP® 86i
* CHIRP LiveScope™ XR System with GLS 10™ and LVS62 transducer Sonar

**Phase 3: Assessment of macro-litter and micro-plastic pollution in the coastal and** **internal shelf area during the autumn season (deadline: 10.12.2023)**

**Phase 3 Activities:**

* **Organizing and preparing the field activities and the analytical methods (09.2023);**

During this activity, the institute's endowment was prepared and the equipment, the necessary materials and supplies were purchased.

* **Carrying out field activities in the coastal area and** **internal shelf (09-10.2023);**

The field activities in the 2 - 13 October and 8 - 13 November 2023 intervals were the continuation of the monitoring program initiated during Phase 1. They included the same sub-activities of water and sediment sampling as those of Phase 1.

* **Sample analysis of samples in the laboratory and the obtaining of quantitative and qualitative data (10-11.2023);**

The processes of sample preparation and microscopic and spectrometric analysis had been carried out in a similar way as those of Phase 1.

* **Data Interpretation and the realization of the phase report, date of delivery report (10.12.2023);**

**Phase 3 Results:**

The visual and spectroscopic investigation process pursued the quantitative and qualitative characterization of the particles extracted from the taken samples, aiming to assess the microplastics concentrations in the same proposed monitoring areas after the ending of the tourist season.

**Phase 3 Equipment:**

* Memmert UN110, natural convection, Single DISPLAY, 108 L Drying Oven
* LAUDA /GFL Puridest PD 2R, 2 L/h Water Distiller