PROTECT-STREAMS-4-SEA

The newsletter of the Protect-Streams-4-Sea (BSB963)

Issue # 3, January 2022

Common borders. Common solutions

Achievements of BSB963 "Protect-Stream-4-Sea" – Moving forward for success

By George N. Zaimes and Valasia Iakovoglou

The new year 2022 has come and we hope that it is a much better year for everyone. We overall wish to everyone that the New Year be full of Joy, Happiness, Success, Love, Peace and based on the current conditions, HEALTH.

BSB963 "Protect-Stream-4-Sea" is progressing, despite numerous difficulties and all partners strongly believe that the end results will be very substantial for the environmental protection of the Black Sea region. New insights on the contributions of inland pollutants and litter, specifically from the rivers and their watersheds that end in the Black Sea are being estimated. A joint monitoring program for pollutants and litter has been established as well as best management practices based on nature-based solutions are being developed. The Black Sea is considered one of the most degraded regional seas and the results of this program will provide viable and sustainable solutions to improve the environmental conditions of the Black Sea leading enhance condition in the region that should also promote sustainable growth and improve the welfare of the people.

Figure 1. Christmas card

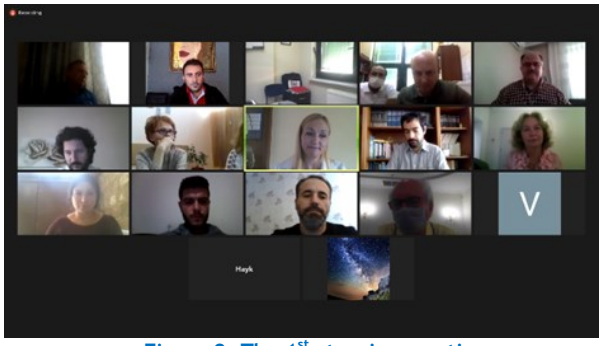

Figure 2. The 1st steering meeting

A key for the success of the project is the coordinated and symmetrical application of monitoring and measuring methodologies in the entire region since there are many different countries sharing a common Sea. Without common methods and practices the condition of the Black Sea will not be improved effectively and sustainably. This is accomplished successfully with in person meeting and training.

One of the major obstacles of the COVID-19 pandemic in regard to international projects and international collaborations has been the lack of "in-person" meetings. Despite the lack of in-person meetings (kick-off, steering committee meetings etc.) the BSB963 partnership is working very well, and we could say that it is thriving. The kick-off and steering meetings were held online with all partners actively participating. In addition, the partners are meeting almost every month and frequently communicating through email, google groups, dropbox, dot.project that has enhance collaboration and minimized the problems of the project. In all meetings, partners are participating with a smile and all are looking forward to meeting with each other in-person. Hopefully this will happen in the spring of 2022 where we have planned in person meetings and workshops!

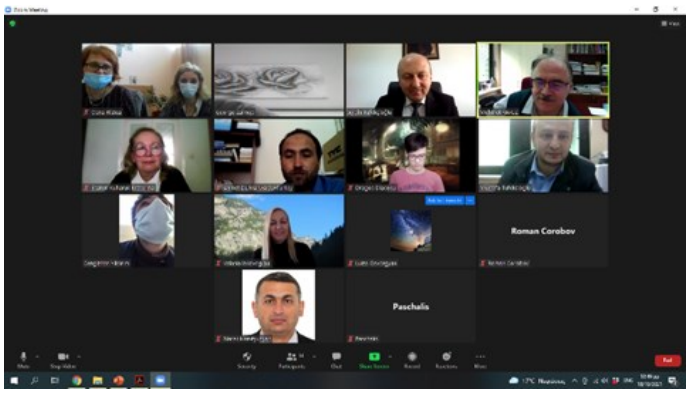

Figure 3. The 2nd steering meeting

Project funded by EUROPEAN UNION

This publication has been produced with the financial assistance of the European Union. The contents of this publication are the sole responsibility of Valasia Iakovoglou, Paschalis Koutalakis et Georgios Gkiatas, (IHU SARF) and can in no way be taken to reflect the views of the European Union.

The restrictions, due to COVID-19, in the field, has caused the delayed installation of the plots in many of the partner countries. Currently all partners have been trying to accelerate their activities in order to minimize the impacts of the delays. Specifically, in regard to "WP T1 - Identifying Hot Spots and Quantifying Erosion, Litter and Pollutant Sources", all partners have installed surface erosion and stream bank erosion plots and are collecting data. In addition, all partners have employed drones to collect images and created maps based on the vegetation images by utilizing satellite and drone images. Some partners have also implemented the hydrologic models, such as SWAT. For "WP T2 - Monitoring and Mitigating Stream Pollutants and Litter all partners", partners have started collecting soil and water samples and their analysis in the laboratory is taking place in order to implement the fingerprinting methods. In addition, suitable nature-based solutions for the region are being determined. Still, both work packages have experienced significant delays that all partner are working very hard and intensely to overcome.

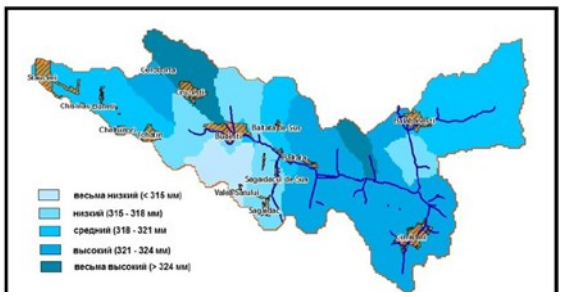

Figure 4. Implementing the SWAT model to estimate annual surface runoff in Moldova

Finally, the dissemination for the project is progressing very well. Specifically, most partners have had awareness events with high participation of the target groups. The photo titled "Streams clean up" from one of the awareness events in Armenia got the "second place in the Black Sea Programme Photo Contest" with more than 500 votes. Neighborhood Network meeting have taken place with stakeholders showing great interest in the project. Partners have been presenting the project's initial results to numerous scientific conferences. George Zaimes won the award for "best paper" for "TRACK 10. Hydrology, Hydrogeology, Hydrochemistry" at the 1st Mediterranean Geosciences Union. Finally, the social media and project website are very active with posts and many followers. The awareness of the project is considered high and effective.

Overall, we believe that 2022 will be a successful year for "Protect-Streams-4-Sea" with innovative methodologies produced and new sustainable results produced and the awareness and acceptance reaching all target groups.

Figure 5. "Best paper" at the 1st Mediterranean Geosciences Union

Figure 6. second place Black Sea Programme Photo Contest

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Current research activities achieved so far - IHU-SARF

By Paschalis Koutalakis

Free SENTINEL -2- satellite images (resolution 10m) were utilized in order to produce indices based on the spatial and image analysis of the captured spectrum in ArcGIS. The images collected include three different dates during the period 2019-2021 (total of 9 images). The two (2) indices produced based on the project activities were: a) the Normalized Difference Vegetation Index (NDVI), b) the Normalized Difference Water Index (NDWI). We developed an additional index c) the Normalized Difference Soil Index (NDSI). These indices maps identified areas that should be further monitored. Currently commercial satellite images of significantly higher (80cm and 50cm resolution) focused on a specific area are being purchased. Furthermore, Unmanned Aerial Vehicles have been utilized to monitor stream/river channel changes in different time -periods. These UAVs images will be analyzed to provide outputs (e.g., orthomosaics, digital surface models and indices) to further investigate the "hot-spots" of erosion. For this scope, different software or GIS toolboxes are tested in order to select the appropriate for the scopes of the project.

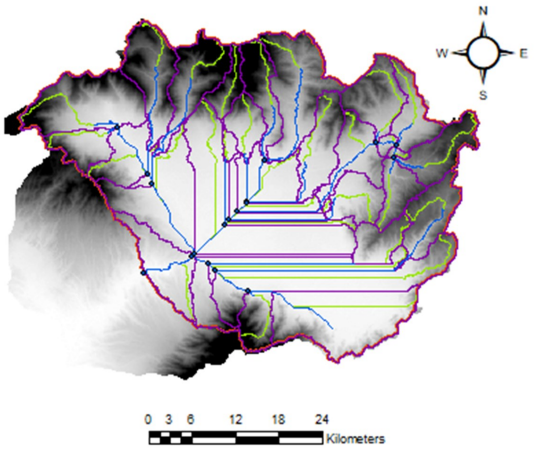

Figure 7. Aggitis watershed delineation using ArcSWAT

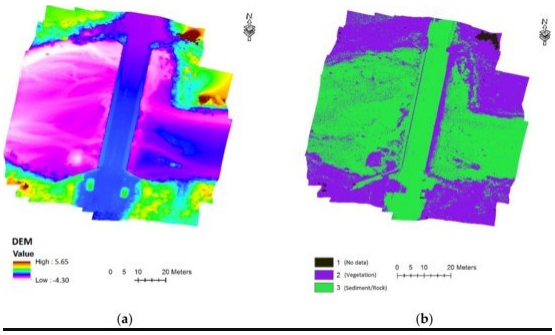

Figure 8. Using new innovative methods such as UAVs to monitor erosion

Hydrologic modeling includes the application of Soil and Water Assessment Tool (SWAT) and Watershed Erosion Prediction Project (WEPP). Both models are available through GIS platforms in order to easily produce the spatial datasets. Currently, the digital elevation model (DEM) and the watershed delineation process through the stream network has been completed. The slope, soil and the land cover map and categorization in SWAT database in addition to the hydrologic response units (HRUs) has been produced. Currently, the weather data are being collected and edited to run the simulation tests. Field data need to be collected (e.g., soil data) to calibrate and validated the two models (SWAT and WEPP). WEPP model set up is the next step. The final step will be the simulation based on climate change scenarios.

In regard to the field monitoring, installation of erosion pins, Gerlach traps and erosion plots has been completed. The entire watershed was divided, based on the land cover categories of CORINE 2018, in five major categories: a) agricultural areas, b) natural grasslands/pastures, c) sclerophyllous vegetation, d) forests and e) riparian vegetation. The number of monitoring stations were placed equally in the different land cover. For the determination of their location, soil, slope, safety and accessibility factors were incorporated. In the end 10 surface erosion plots (2 in each land cover), 5 Gerlach traps (1 in each land cover) and 40 erosion pins (10 in each of the first 4 land-covers along riparian areas).

Figure 9. Installed erosion pins in Greece

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Activities in frames of the T1 - Satellite image processing and determination of erosion-prone areas-Eco-TIRAS

By Igor Sirodoev

In the first phase of the analysis, there were used freely available satellite scenes acquired using Thematic Mapper *(TM)* and MultiSpectral Instrument *(MSI)* sensors on the board of Landsat 5 and Sentinel-2 missions, accordingly. To detect erosion-prone areas, we used early spring and late autumn images, acquired at the close dates in the months, in which vegetation cover is less developed. Less than 5% of cloud cover was, among others, one of the important image quality criteria. The selected scenes were processed in the cloud (radiometric and geometric correction) and downloaded using Google Earth Engine. Thus, we got six images: three for spring and three for autumn. Each set of scenes covers the period between 1986 and 2020, while having one intermediate date in the middle, which differs for spring and autumn datasets due to scene availability: April and October for 1986 and 2020 as well as April 2000 and September 2003 for the intermediate date. Finally, we computed Normalized Difference Vegetation Index (NDVI) using the "RStoolbox" package developed for *R* statistical computing environment.

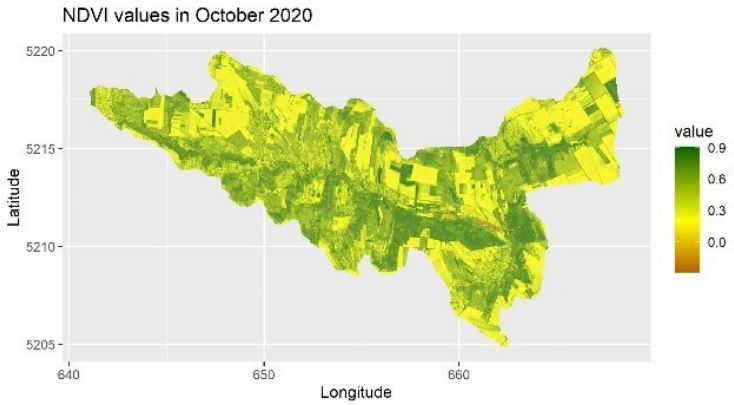

Figure 10. NDVI values in October 2020

In the next phase, we determined the erosion-prone areas. According to the reviewed literature, the generally accepted *NDVI* value threshold for the bare ground is 0.2. That is, it is much more likely that pixels having *NDVI* <= 0.2 are covered with sparse vegetation or have no vegetation at all. In such a way, these areas become the most exposed to surface erosion processes. Additionally, we used ancillary information, such as soil type distribution or land-use types, to determine whether we can find any confinement between these categories and lands exposed to degradation. The urban land-use type was excluded from further analysis as we are not interested in erosion on built-up lands. However, we kept water-covered areas because they were not constant across the analyzed period. Moreover, as our further analysis has shown, areas close to water bodies, especially those in the upper part of in-stream ponds, are among the most vulnerable to erosion.

To determine the erosion-prone areas we used a two-step process based exclusively on remotely sensed data *(NDVI)*. First, we selected pixels with *NDVI* values <= 0.2 in any of the analyzed years. Second, we kept just pixels, which had the values below the threshold in at least two (out of three) analyzed years. The obtained erosion-prone areas were divided into two types, depending on the pixel distribution by seasons: pixels with critical values in both seasons (Spring and Autumn) were attributed to the "high exposure" category, with pixels with critical values in either of the seasons were labels as "moderate exposure".

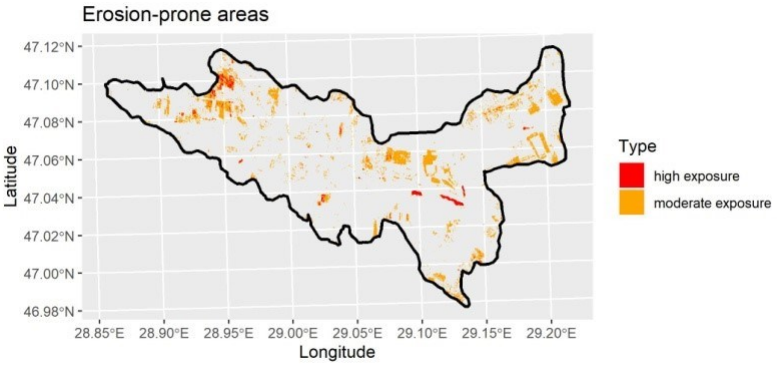

Figure 11. Erosion-prone areas

Thus, quite a large area is exposed to erosion: about 1439 ha (8.6% of the basin's area). The most critical areas

represent just 9.6% of the total erosion-prone areas, while the rest 90.4% is moderately exposed. In distribution by land-use types and soil categories the relationship is usually simple: the larger the area occupied by a certain category the larger its share in erosion-prone areas. Thus, croplands having the highest share in land use have the highest share in the erosion-prone areas (91.7 %). The same thing happens to chernozems, whose share in erosion-prone areas is almost 90%. We also should highlight some critical findings:

About 70% of highly exposed areas are located on croplands, while the other 28% are close to water-covered areas;

About 80% of fluvisols are highly exposed to erosion, constituting 29% of erosion-prone areas;

More than 87% of areas located close to water bodies are highly exposed to erosion.

In conclusion, we should emphasize the importance of the following land-use and soil types for erosion, namely croplands and chernozems, which have the highest shares in the basins area, and fluvisols and water-bodies, which constitute abnormally high shares in erosion-prone areas (especially the highly exposed ones).

Activities in frames of the T1 - Satellite image processing and determination of erosion-prone areas-Eco-TIRAS

By Ecaterina Kuharuk and Olga Crivova

In frames of the T2 activities, the soil and water samples for investigating the sources of pollution from the industries were collected on the territory of the pilot area of Baltata river's basin. The samples were analysed in the Laboratory of Pedology and the Laboratory of the Chemical analyses, e.g. the heavy metals analysis was performed according to the ISO 8288 (Cadmium, cobalt, nickel, copper, lead and zinc).

Physical and chemical analysis of soil samples: physical and mechanical properties (water permeability, mechanical composition, etc.) that are necessary for calculating soil losses on slopes were estimated. To assess the volume of soil loss on slopes, we used the universal equation of soil loss RUSLE 2015, which took into account the humus content, particle size distribution, structure, and permeability.

The following field experiments are now in the process of implementation:

- Runoff plots,
- Stream Bank Plot Methods (Erosion pins),
- Rainfall simulators,
- Estimation of erosion levels by Cs-137 content in soil.

Figure 12. Runoff plots on heavily eroded soils

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Current research activities achieved so far – BIWA-RO

By Daniel Diaconu and Ristea Oana

To identify the hot spots of erosion in the pilot area based on previous data and satellite images were applied in the GIS environment Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Water Index (NDWI). Based on dense green vegetation and water cover, the pilot area does not show major erosion phenomena. However, several hotspots have been identified and monitored during 2021 by installing two Gerlach traps to monitor soil erosion and erosion pins for stream erosion. Following the monitoring it was found that soil erosion did not occur, while stream erosion occurred, but on a small area.

Figure 13. Gerlach trap

The processing of satellite images was performed, fractal methods of analysis were applied in the area where the study area is located, to determine the variation of the areas covered with forest;

Figure 14. Microplastic sampling

Data on the evolution of forested areas were correlated with the quantities of alluvium transported on the Buzau River and a bathymetric survey of Lake Siriu was performed for estimating the reservoire clogging rate. The bathymetric characteristics of Siriu lake was done using a self-contained underwater vehicle YSI ECO MAPPER (A.UV) equipped with BIWA. The measured data is to be processed and interpreted.

The main diffuse sources identified in the pilot area are plastic waste, activities being focused on collection and sorting of plastic waste, identification of types of plastic waste and studying the presence of microplastic in sediment and water.

In every hotspot in the pilot area we inventoried the plastic waste present, we sorted each plastic waste accordingly according with Master List of Categories of Litter Items from Guidance on Monitoring of Marine Litter in European Seas, we filled the List of Plastic Waste (adaptation of List of Litter Categories for Marine Macrolitter Monitoring, and we noted type and number of items. The information collected from the field represents the database for the evaluation study of plastic pollutants in the pilot area that may reach the Black Sea.

To investigate the presence of microplastic in sediment and water, sediment and suspensions samples were taken from 4 sites on the Siriu reservoire and 4 sites from the Buzau river. The sampling was performed according to the Standard operating procedure (SOP) drawn up within the project, the sediment samples being taken with Grab Sediment Sampler and with Hand Corer Sediment Sampler, and the suspension samples with neuston net. The samples will be analyzed microscopically. Some fragments of plastic waste (from sediments and water samples) will be analyzed by FTIR Spectrophotometry to identify the type of plastic polymers from which they are made and to identify the origin of these fragments.

Figure 15. Hand Corer Sediment

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Current research activities achieved so far – ACU

By Mehmet Yavuz , Mustafa Tufekcioglu, Ahmet Duman, Can Vatandaşlar and Aydın Tufekcioglu

In the 4th period of the field monitoring, periodic (fall) measurements of erosion pins were conducted on the stream/river banks. Other periodic data collections, including water and soil samples, were also conducted across the watershed. Stream flows are measured periodically with a flow meter. More soil samples have been collected for finger printing analysis. The soil samples collected for fingerprinting were partly analyzed for texture and other chemical properties in the soil lab. We identified and mapped 182 hotspots (landslides and land clearance) using the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Water Index (NDWI) that we extracted from SENTINEL-2 satellite images. In addition to NDVI and NDWI, we used an additional index, the Normalized Difference Soil Index (NDSI), to double-check the data.

Figure 16. Water sampling in Arhavi River Watershed

Furthermore, the Unmanned Aerial Vehicles (UAVs) have been utilized to capture the current conditions of the "hot-spots" that were extracted from SENTINEL-2 satellite imagery during 2019-2021 periods. Each UAV images captured on were utilized to create ortho-photos, 3D digital terrain (DTM) and digital elevation (DEM) models of hot-spots within the watershed. Furthermore, size, dimension, and volume of soil loss of each hot-spots were measured from these DTMs.

Figure 17. ChSoil sampling in Arhavi River Watershed

The UAVs were also utilized to identify and digitize elements such as stream centerlines, widths, base flow, bankfull length, flood plain, deposited and eroded areas, bank height and bank angle for the GIS Stream Bank Erosion Index. The thermal sensor of the UAV was utilized to map the source and extend of the water within each hot-spots. We believe that the water content within the hot-spots are the driven forces for the water erosion and leads to potential carrier for the pollutants into the Black Sea.

Figure 18. Drone surveying of the stream bank erosion index in Arhavi River Watershed

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Awareness event "Protect-Streams-4-Sea" Project- Armenia

"Young Foresters Union" NGO is implementing "Protecting streams for a clean Black Sea by reducing sediment and litter pollution with joint innovative monitoring and control tools and nature-based practices (BSB963)" with the acronym "Protect-Streams-4-Sea" funded under the EU INTERREG IV "Black Sea Basin Joint Operational Programme 2014-2020" with the participation of relevant organizations from 4 partner countries. In Armenia, the project activities are carried out in the Debed River basin.

A total of 70 participants were participating in the awareness event that was organized within the framework of the project at the School Forest District's Field Training Center near Koghb village, Tavush region during July 27-29, 2021. The participants included the head of Koghb enlarged community, community Council members, the director and staff of the Armenian branch of the World Wildlife Fund, members involved in the school forest district, participants/schoolchildren from the settlements adjacent to the Debed River, as well as the relevant specialists of the project.

Figure 19. Cleaning of the river bank

The program of the event was very rich and interesting designed with presentations on environmental issues, competitive assignments, painting contest on environmental themes, orienteering sports in the forest, while in the evenings artistic events around the bonfire were organized. Cleaning works of the nearby river and coastal areas was organized on the last day of the event. The winners of the contests were encouraged with special gifts.

Awareness event: The use of new technologies to estimate erosion and pollution in Drama, Greece - IHU-SARF

By Georgios Gkiatas & Iordanis Kasapidhs

George Zaimes, Paschalis Koutalakis, Georgios Gkiatas, Georgios Pagonis and Iordanis Kasapidis showcased the methodologies that are being implemented in the BSB963 "Protect-Streams-4-Sea" project. The event was on November 18th, 2021 that was held in the Agia Varbara Park of Drama, Greece. The main purpose of this event was to explain to more than 60 university students the importance of the erosion pins which measure stream bank erosion, soil samples that help us evaluate the properties of different types of soil, run off plots which help us evaluate surface erosion and the importance of using new technologies like deeper smart sonar chirp+ and submarine drones to be able to estimate more efficiently erosion and pollution. in the. The students that participated showed great interest in the project since they got ideas for future semester projects but also were interested to participate in the project as volunteers in future activities.

Figure 20. Stream bank erosion pins

Figure 21. The participants of the event

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BIWA Material - Awareness event

By Maria Marinescu

Figure 22. The pupils visit on the canopy of the Siriu Dam

On March 22, 2021, on the occasion of World Water Day, Buzau-Ialomita Water Administration launched a contest called "We don't care" in which 9 teams from the 3 educational units that are part of the target groups entered. The participating teams prepared useful objects (pencil holder, vases, flower pots, jewelry, etc.) by reusing plastic objects (packaging). The aim of this competition was to raise awareness of the fact that single-use plastic objects can be transformed into multi-purpose objects.

On 16.06.2021 within the activity "Water and our dependence on PLASTIC) took place the awarding of the winners of the contest. The award ceremony was followed by a short presentation when the pupils found out about the pollution with plastic waste (presented by Oana Ristea, assistant of the project manager) the harmful effects of plastic for aquatic organisms but also for HUMAN.

The second part of the action was dedicated to the Siriu reservoir. Thus, the pupils learned the history of the construction of the Siriu reservoir and its uses from Laura Zaharia (director of SGA Buzau). The activity ended with a visit to the canopy and the dam gallery. During the awareness event called "The PETscuit season has opened" organized on July 11, 2021 by the Buzau-Ialomita Water Administration, a large-scale plastic waste collection action was organized in the pilot area: Siriu Reservoir and Buzau River. On behalf of the organizers, Marinescu Maria, Oana Ristea, Daniel Diaconu, Alina Constantin and Laura Zaharia participated. This event was attended by about 130 volunteers from: Buzau-Ialomita Water Basin Administration; Buzau County Prefect's Institution; Buzau Hydrotechnical System; Buzau Emergency Situations Inspectorate; Siriu and Nehoiu City Halls; pupils from "Nicolae Iorga" Theoretical High School from Nehoiu; students from the University of Bucharest-Faculty of Geography; 4 NGOs - Outdoor Events PatarlageleAssociatia Sportiviv Profesional de Rafting-Brasov, Green Adventure and Leytto Events Company SRL Nehoiu. The volunteers were divided by the organizers into teams and were distributed in different areas of the Siriu reservoir. After the completion of the action, about 1000 bags representing a volume of about 50 cubic meters were collected and taken over by SC RER SUD Buzau for valorification. The participants expressed their desire to participate in such events as volunteers in order to reduce water pollution and protect the environment in general.

Figure 23. Buzau Emergency Situations Inspectorate Volunteers collecting waste from the Siriu reservoir bank

DISSEMINATION & COMMUNICATION

Publications in scientific journals

- Corobov, R., Syrodoev, G., 2021. Rainfall erosivity and climate change: some estimations for the Baltata River basin. Buletinul Institutului de Geologie şi Seismologie No1, pp. 78-85.
- Sîrodoev, I., Corobov, R., Sîrodoev, ., Trombitsky, I., 2022. Modelling Runoff within a Small River Basin under the Changing Climate: A Case Study of Using SWAT in the Bălțata River Basin (The Republic of Moldova). Land, 11(2), 167; https://doi.org/10.3390/land11020167

International and local conferences

- Yildirim, C., Tufekcioglu, M., Duman, A., Tufekcioglu, A., Satiral, C., Vatandaslar, C., Yavuz, M., Zaimes, G.N., 2021. The effect of the Arhavi flood on channel and gully erosion processes. Proceedings of the IV. National Congress "Black Sea Forestry", Karadeniz Technical University, Trabzon, Turkey, December 6-9th 2021 (online). Presenter: Cengizhan Yildirim.
- Tufekcioglu, M., Yildirim, C., Duman, A., Vatandaslar, C., Satiral, C., Yavuz, M., Tufekcioglu, A., Zaimes, G.N., 2021. The "Integrated Watershed Management" concept in the context of flood and torrent risk mitigation: July 22nd Arhavi flood case. Proceedings of the IV. National Congress "Black Sea Forestry", Karadeniz Technical University, Trabzon, Turkey, December 6-9th 2021 (online). Presenter: Mustafa Tufekcioglu.
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- Zaimes, G., Iakovoglou, V., Koutalakis, P., Gkiatas, ., Marinescu, M., Ristea, O., Ghulijanyan, A., Gevorgyan, L., Trombitsky, I., Kuharuk, E., Tufekcioglu, M., Tufekcioglu, A., 2021. Identifying the sources and the contributions of inland sediment and litter pollutants to enhance the Black Sea through nature-based solutions. Proceedings of the Mediterranean Geosciences Union Annual Meeting (MedGU-21), Istanbul, Turkey, 25-28th November 2021. Presenter: George Zaimes.
- Zaimes, G., Koutalakis, P., Gkiatas, G., Iakovoglou, V., Marinescu, M., Ristea, O., Ghulijanyan, A., Gevorgyan, L., Kuharuk, E., Trombitsky, I., Tufekcioglu, M., Yavuz, M., Tufekcioglu, A., 2021. Protecting streams for a clean Black Sea by reducing sediment and litter pollution with joint innovative monitoring and control tools and nature-based practices. Proceedings 7th International Conference on Water Resource and Environment (WRE 2021), Xi'an, China, Hybrid mode (Online and Offline). November 1-4, 2021. Presenter: George Zaimes.

Press Releases

- BSB963-Protecting streams for a clean Black Sea by reducing sediment and litter pollution with joint innovative monitoring and control tools and naturebased practices. In Forest Information Billboard, Issue 4, December 2021 published quarterly by United Nations Economic Commission for Europe (UNECE) & Food and Agriculture Organization of the United Nations (FAO) (see https://unece.org/forest-informationbillboard).

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