EU4Environment in Eastern Partner Countries:
Water Resources and Environmental Data (ENI/2021/425-550)

SURFACE WATER SURVEY GEORGIA 2022

Contract-No: 20940-C1/GE-NEA-2022/1

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Funded by
the European Union

EU4Environment
Water and Data in Eastern Partner Countries

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ABOUT THIS REPORT

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ABOUT EU4ENVIRONMENT – WATER RESOURCES AND ENVIRONMENTAL DATA

This Programme aims at improving people's wellbeing in EU's Eastern Partner Countries and enabling their green transformation in line with the European Green Deal and the Sustainable Development Goals (SDGs). The programme's activities are clustered around two specific objectives: 1) support a more sustainable use of water resources and 2) improve the use of sound environmental data and their availability for policy-makers and citizens. It ensures continuity of the Shared Environmental Information System Phase II and the EU Water Initiative Plus for Eastern Partnership programmes.

The Programme is implemented by five Partner organisations: Environment Agency Austria (UBA), Austrian Development Agency (ADA), International Office for Water (OiEau) (France), Organisation for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE). The action is co-funded by the European Union, the Austrian Development Cooperation and the French Artois-Picardie Water Agency based on a budget of EUR 12,75 million (EUR 12 million EU contribution). The implementation period is 2021-2024.

https://eu4waterdata.eu

January 2023

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List of abbreviations

ADA .... Austrian Development Agency
BQE .... Biological Quality Elements
DoA .... Description of Action
DG NEAR .... Directorate-General for Neighbourhood and Enlargement Negotiations of the European Commission
EaP .... Eastern Partners
EC .... European Commission
EECCA .... Eastern Europe, the Caucasus and Central Asia
EMBLAS .... Environmental Monitoring in the Black Sea
EPIRB .... Environmental Protection of International River Basins
ESCS .... Ecological Status Classification Systems
EU .... European Union
EUWI+ .... European Union Water Initiative Plus
GEF .... Global Environmental Fund
ICPDR .... International Commission for the Protection of the Danube River
INBO .... International Network of Basin Organisations
IOW/OIEau .... International Office for Water, France
IWRM .... Integrated Water Resources Management
NESB .... National Executive Steering Board
NFP .... National Focal Point
NGOs .... Non-Governmental Organisations
NPD .... National Policy Dialogue
OECD .... Organisation for Economic Cooperation and Development
RBD .... River Basin District
RBMP .... River Basin Management Plan
Reps .... Representatives (the local project staff in each country)
ROM .... Result Oriented Monitoring
ToR .... Terms of References
UBA .... Umweltbundesamt GmbH, Environment Agency Austria
UNDP .... United Nations Development Programme
UNECE .... United Nations Economic Commission for Europe
WFD .... Water Framework Directive

Country Specific Abbreviations Georgia

MENRP .... Ministry of Environment and Natural Resources Protection
NEA .... National Environment Agency
NWP .... National Water Partnership

Executive Summary

This report has been prepared within the frames of the Agreement [N 20940-C1/GE-NEA-2022/2] executed for "EU4Environment Water and Data" by the NEA. The subject of agreement was surface water monitoring in the western part of Georgia. This report presents the results of this survey which included both chemical and biological sampling and analyses in the Rioni-Enguri basin.

The main objective of the survey was to carry out a harmonized data collection, which shall form a basis for the evaluation of existing or development of new assessment methods for the biological quality element "benthic invertebrates" in selected river types of Georgia. Based on this method, the ecological status of the rivers and water bodies included in this survey are classified. These results contribute to the status assessment and risk analysis within the national river basin management plan and form a sound methodological basis for future monitoring programs.

All analyses were done in accordance with the laboratory accreditation procedures. The transport, storage, (if necessary) preservation and the chemical analysis was done according to the laboratory accredited procedures together with the application of internal analytical quality controls (AQC). These results were recorded together with the analysis of the samples for all the chemical parameters. The analysis record includes the sampling date and the analysis date ensuring compliance with the attached manual on sample preservation.

1. Introduction and Scope

The objective of the survey in autumn was a sound methodological basis for future monitoring programs as essential part of river basin management planning (Table 1).

Table 1: Parameters analyzed in the field and in the laboratory.

Country	Georgia
River basin	Rioni-Enguri
Campaign [1)]	2022
Objective	Surface Water Monitoring Programe
Quality elements	Biological quality components: **X Macrozoobenthos** ☐ Phytobenthos Supporting elements: **X Hydro-morphological site desription** **X General physico-chemical quality elements**
Preparation of field work	23 – 25 September 2022
Field work	26 September – 02 October 2022
Chemical analyses	03 October – 17 October 2022
Biological analyses	October – November 2022
Reporting	October - November 2022
Submission of technical report	December 2022

1.1. Hydrology

The Rioni River (with sites No. 1 Oni, No. 2 Utsera, No. 8 Khidikari and No. 10 Alpana) originates on the southern slope of the Caucasus Range near the Price Mountain, 2620 m asl, and joins the Black Sea near the city of Poti. The length of the river is 327 km, the average slope is 7.2 ‰, the catchment area is equal to 13,400 km, and the average height of the Rioni river catchment is 1084 m asl. The hydrographic network of the Rioni river basin is well developed. The frequency coefficient of the river network is 1.04 km/km^2 on the left side and 0.92 km/km^2 on the right side of Rioni, with an average of 0.99 km/km^2.

The river Rioni has large tributaries in the Kolkheti plain after its exit. Its main tributaries are: Jojora (with a length of 50 km), Kvrila (140 km), Khanistskal (57 km), Tshnistskal (176 km), Noghela (59 km), Tekhura (101 km), Civi (60 km). Eight tributaries have a length of 25 to 50 km, 14 tributaries have a length of 10 to 25 km, and the remaining 355 tributaries have a length of no more than 10 km each. Their total length of the river network is 720 km. The catchment basin of the river occupies half of Western Georgia. Its largest part (68%) is located on the southern slope of the Caucasus Range, 13% of the river basin is on the northern slopes of the Adjara-Imereti Range, and the remaining 19% is on the Kolkheti Plain. The Rioni River is fed by glaciers, snow, rain and ground water, with snow and rainwater predominating. Its water regime is characterized by spring-summer floods, but floods can occur throughout the year. The maximum runoff on the river is observed in spring, when 38.8% of the annual runoff flows. 18% of annual runoff flows in autumn, and 19.7% in winter. The distribution of annual runoff between months is very uneven. The maximum runoff is usually observed in the month of May and is 13.9% of the annual runoff, while the minimum runoff is recorded in January and is equal to only 5% of the annual runoff.

Rioni is navigable, the waters of the river are used for irrigation. There is a Rioni cascade of hydropower plants which operates on the river. The speed of the river flow makes it extremely dangerous for kayaking, but the lovers of extreme sports sail in inflatable boats. The rafting season is in spring and autumn.

The Kvrila River (with site No.1 Sachkhere and No. 2 Chiatura_Bridge) originates on the southern slope of the Rachi mountain range, in Ertso Kebbuli. It flows from the Ertso Lake at an altitude of 1711 m asl and flows into the Vartsikhi Reservoir. Before the construction of the reservoir, it joined the river Rioni from the left side. The length of the river is 140 km, the total fall is 1628 m, the average slope is 11.6 ‰, the area of the basin is 3598 km^2, the average height of the basin is 790 m asl. The river has 2906 tributaries of different orders with a total length of 5254 km. The main tributaries of Kvrila are Gvizhga (19 km), Gedura (13 km), Lashura (13 km), Chikhura (21 km), Zhruchla (18 km), Sadzalikhevi (10 km), Katzkhura (13 km), Dzirula (94 km). , Cholaburi (20 km), Lukhuta (21 km), Shabetaghele (15 km), Peshavia (15 km), Tskaltsitela (49 km). The frequency coefficient of the river network in the catchment basin is 1.45 km/km^2. The river is fed by snow, rain and groundwater, while the role of snow in the river's discharge increases in the highlands. Groundwater plays a minor role in the river's water balance. The water regime of the river is characterized by spring and autumn floods, whereas water scarcity usually occurs in summer and winter, occasionally disrupted by flash floods caused by rains. Particularly intense floods are observed in autumn, which are caused by long rains. Fall floods exceed spring flood levels in their height, and annual maximums are more often recorded in autumn. In Sachkheri zone, 44.2% of annual runoff flows in spring, 18.6% in summer, 18.2% in autumn and 19.0% in winter. Icy events, mainly in the form of floes, are recorded in the middle of the Kvirila River in individual cold winters. Kvirila River is used for irrigation and energy purposes.

The Jejora River — the left tributary of Rioni in Oni municipality (with site No. 3 Oni). It originates on the southwestern slope of Maghran-Dvaleti Caucasus, at an altitude of 2975 m asl, length is 45 km, basin area is 438 km^2. It is fed by snow, glacier, rain and underground water. Flooding is known in spring and summer. Persistent water scarcity occurs in winter. Flooding caused by rains is especially large in autumn. 65% of the annual runoff flows during floods, 21% in autumn, 17% in winter. The average annual flow at the estuary is 12.2 m^3/s.

The Lukhunistkshali River — the right tributary of the Rioni, in the Ambrolauri region (with sites No. 6 Uravi upstream and No. 7 Uravi downstream). It originates on the southern slope of the Lechkhumi ridge, at an altitude of 2650 m asl. Length 39 km, basin area 239 km^2. It is fed by snow, rain and underground water. Floods are known in spring, summer and autumn, water scarcity occurs in winter. The average annual consumption is 12.1 m^3/s. village A hydroelectric power plant is built on the Urav river.

The Krikhula River — in the Ambrolauri region (with site No. 9 Ambrolauri). The length is 15.2 km. The area of the basin is 134.6 km^2, its source is on the northern slope of the Rachi ridge. 1480 m asl and joins the River Rioni in Ambrolauri. It is fed by rain, snow and underground water. Floods are known in spring, water scarcity in winter, summer-autumn is characterized by floods again. The average annual flow at the estuary is 3 m$^{3/}$s.

The Tskhenistskali River (with sites No. 11 Lentekhi and No. 12 Luji) originates in the central part of the Caucasus range, south of the Sharivtsek pass, from the glacier at 2700 m asl and joins the Rioni river from the right side, 1.3 km southwest of Sajavakho village. The length of the river is 176 km, the total fall is 2684 m, the average gradient is 15%, the area of the catchment basin is 2120 km^2, and the average height of the basin is 1660 m asl. The river has 897 tributaries of different orders, with a total length of 2200 km. Of the tributaries, Zeskho (19 km long, with site No. 13 Tsana in the tributary Koruldashi), Gobishuri (12 km), Laskanura (20 km), Khledula (34 km), Lektareshi (24 km), Janaula (21 km) and others are important. The frequency coefficient of the river network is 1.09 km/km^2. The area of glaciers in the river basin is 12.9 km^2. The main shaper of river runoff is snowmelt water. The river is fed by snow, rain, ground and glacier water. Its water regime is characterized by spring-summer floods and well-defined winter water scarcity. 70-75% of annual runoff flows in spring-summer, 18-20% in autumn, and 8-10% in winter. The river is used for irrigation and energy purposes. Above the town of Tsageri, from the left bank of the river, a 6.5 km long tunnel has been built, through which the river Water from Tshnisskli in the amount of 50-60 m^3/s is supplied to Lajanuri reservoir for energy purposes. The reservoir created on the Lajanuri river, which receives additional nutrition from the river. From Tshnisskali, operates the Lajanur power plant, the produced water of which flows into the river. in Lajanur and then in Md. Rioni. on the river, village Near Matkhodji, the main structure of the Khoni-Samtredia irrigation system has been installed. The mentioned irrigation system serves to irrigate 1200 ha of the Imereti region.

The Enguri River (with sites No. 14 Vichnishi, No. 19 Potskho-Etseri, No. 20 Khaishi and No. 24 Anaklia Confl. Black Sea) originates from the foothills of the mountains on the Caucasus Range (5058 m asl) and Nuamkuan (4278 m asl) glaciers of two streams. The Enguri runs into the Black Sea at the town of Anaklia. The length of the river is 213 km, the total drop is 2520 m, the average slope is 11.8 ‰, The area of the catchment basin is 4060 km^2, the average height of the basin is 1840 m asl. There are 242 tributaries with a total length of 872 km. Among them the following are important: Odishchala (length 15 km), Mulkhura (27 km), Dolra (20 km), Nakra (22 km), Nenskra (46 km), Tcheishi (18 km), Larakwakwa (17 km), Mmagana (24 km), Rukh (21 km), and Jumi (61 km). The river basin has an asymmetric shape. The right side of the basin is 2317 km^2 large and the left side 1743 km^2. 74.5% of the basin is mountainous, and 25.5% is spread over the foothills and plains. 174 glaciers are found in the highland zone of the basin with a total area of 333 km^2.

The upper zone of the basin, from the beginning of the river to the confluence of Nenskra, is mountainous Kebuli, which is known as Kebuli of Svaneti. This area of the basin is bordered by the Caucasus mountain range from the north and northeast. The highest and most glaciated section has an average altitude 3000-3500 m asl. It includes the famous peaks of the Caucasus range: Shkhara (5058 m), Tetnuld (4851 m), Ushba (4696 m), Aylama (4544 m) and others. The river is fed by glaciers, snow, rain and groundwater. An important part of runoff is coming from snow, rain and runoff from glaciers. The water regime of the river is characterized by annual floods during the warm period and unstable water shortage in the cold period. Floods caused by melting glaciers are often accompanied by rains. Floods in periods of intensive precipitation can occur even in periods of water scarcity. 80-82% of annual runoff flows in the warm period of the year, when there is snow and intensive melting of glaciers. Discharge in the cold period is only 7-8%. The river is used for hydropower. A 271.5 m high arched dam became operational in 1978. This dam creates a large impoundment with a total volume of 1100 million m^3, of which 680 million m^3 can be used for energy production. The Enguri dam and reservoir has completely regulated the flow of the river runoff downstream.

The Mestiachala river (with site No. 15 Mestia upper) in Mestia municipality originates on the southern slope of the main Caucasian range of Svaneti, from Lekhzir and Chalaati glaciers. It is attached to the town of Mestia from the right side of Mulkhra river. Total length is 11 km, the basin area is 152 km^2. It is fed by glacial, snow, rain and underground water. Floods are known from April to October, water shortages occur from October to April, in winter - ice and snow. The average annual consumption is 7.29 m^3/s.

The Nakra River — on the southern slope of the Svaneti Caucasus, the right tributary of the Enguri (with site No. 17 Nakra Water intake). It originates at an altitude of 2870 m asl. Total length is 22 km, the basin area is 169 km^2. It is fed by glacier, snow, rain and underground water. Floods are known in spring and summer, water scarcity occurs in winter, floods in autumn. The average annual consumption is 18.8 m^3/s. In winter, ice sheets, bottom ice and slush appear.

The Dolra River — the right tributary of the Enguri River, on the southern slope of the Svaneti Caucasus, in Mestia municipality (with site No. 16 Ushkhvani). It starts from Dolra Glacier. Total length is 24 km, the basin area is 191 km^2. The river is fed mainly by glacial water. Flooding is known in late spring, water is low in winter. The average annual consumption is 9.30 m^3/s.

The Chkhoushia River — river in Western Georgia, in Zugdidi and Tsalenjikh municipalities of Samegrelo-Zemo Svaneti region (with site No. 22 Zugdidi). Right tributary of Jum River.The total length of the river is 41 km, and in the territory of Zugdidi it is 37.5 km. Chkhousi is formed by the rivers Big Chkhou and Little Chkhoushia.

The Nenskra River — on the southern slope of the Svaneti Caucasus, the right tributary of the Enguri (with site No. 18 Kvemo Marghi). Total length is 42 km, the basin area is 623 km^2. It originates at 2915 m asl and is fed by glacier, snow, rain and underground water. Floods occur in spring and summer, water shortages occur in winter, in autumn there are floods, in winter there are ice banks, bottom ice, snow. The average annual consumption is 40.1 m³/s. They are used for sawing wood.

The Jumi River (with site No. 23 Darcheli) — in Zugdidi municipality, the left tributary of Enguri, originates in the southern foothills of Egris ridge, 310 m asl, total length is 61 km, the basin area is 379 km². The river is fed by rain, underground and snow water. There are floods throughout the year, water scarcity occurs in the summer. The average annual flow at the estuary is 11.6 m³/s.

The Chanitskali River (with site No. 21 Jikhashkari) — It flows in western Georgia, in the territory of Tsalenjikh, Chkhorotsku and Khobi municipalities of Samegrelo-Zemo Svaneti region. Right tributary of Khobistskal. It originates on the southern slope of the Egris ridge, at an altitude of 1960 m asl. The source of Chanisskali is the river Tsentskari. Total length is 63 km, the basin area is 315 km². It is fed by rain, snow and underground water. He knows floods in spring, scarcity of water in winter. From the right tributaries, the Intsra River is worth mentioning, and from the left tributaries, the Abanosghele River. In the valley of the latter is located the sulfate-chloride sodium-calcium healing mineral water Skuri. Many settlements have been built on the banks of Chanistskali, including the administrative center of Tsalenjikha municipality, the city of Tsalenjikha. On the left bank of Chanisskali is the medieval fortress Skur Castle. The average annual discharge at the estuary is 14.5 m³/s.

The Khobi River (with sites No. 25 Khobistskali-Gamogma Sua Khorga and No. 26 Khobistskali-Khobi) originates on the southern slope of the Samegrelo ridge, 1.7 km southeast of the peak Lakumurash-Dudi (3111 m asl), at an altitude of 2326 m asl. It is the third longest river in western Georgia, after Enguri and Rioni. It goes in the southwest direction and joins the Black Sea near the village of Kulev. Its length is 150 km, the average height of the basin is 560 m asl, the average slope is 15.4%, the catchment area is 1340 km^2, the average annual flow at the mouth is 50.5 m^3/s, the specific runoff is 54.0 l s^{-1} km^{-2}, which increases with the height of the basin and reaches 77 l s^{-1} km^{-2} in the upper parts of the basin. It brings 1,765 km^3 of water into the Black Sea every year. Flooding occurs in the spring season, water scarcity in winter. Its main tributaries are Ochkhomuri (47 km long), Chanistskali (63 km long), Skurcha (13 km long), and Zana (42 km). The total length of tributaries is 1995 km, and their total number reaches 1412. The hydrographic network is quite well developed in the mountains, the average density of the river network of the basin is 1.78 km/km^2. In the upper course, the slope varies from 25 to 190‰ but decreases to 9‰ (near the village of Mukhur) and further to 2‰ (near the town of Khobi),. In the lower course, namely on the Kolkheti plain, the river has a smaller slope of 0.4-0.2‰. Khobi River is fed by snow, rain and groundwater. Within the mountainous zone of the basin, its water regime is characterized by long spring floods and unstable winter water scarcity. The water regime mentioned is often broken by short-term floods caused by rains. By its regime, it is a representative of Black Sea type rivers.

1.2. Description of problem and determination of sites

Exact locations of the sampling sites were discussed by the project staff and appropriate units of MEPA and NEA (Water Management and Pollution Monitoring). No problems were encountered during the preparation.

The survey included the following activities:

- Sampling of surface water at 30 sampling sites for analysis of general physico-chemical parameters
- Sampling of benthic invertebrates
- hydromorphology
- Field protocol and site description
- Analyses of general physico-chemical and biological parameters
- Reporting

The sampling points are presented in the Table 2.

Table 2: Sampling sites with geographical coordinates.

Site Nr.	RBD	River name	Site name	Latitude	Longitude
1.	Rioni	Kvirila	Sachkhere	42° 20.175'	43° 24.513'
2.	Rioni	Kvirila	Chiatura_Bridge	42° 17.118'	43° 16.674'
3.	Rioni	Jejora	Oni	42° 34.429'	43° 25.796'
4.	Rioni	Rioni	Oni	42° 34.896'	43° 26.003'
5.	Rioni	Rioni	Utsera	42° 38.927'	43° 33.166'
6.	Rioni	Lukhunistskali	Uravi Upstream	42° 39.316'	43° 17.926'
7.	Rioni	Lukhunistskali	Uravi Downstream	42° 38.352'	43° 17.295'
8.	Rioni	Rioni	Khidikari	42° 31.882'	43° 11.291'
9.	Rioni	Krikhula	Ambrolauri	42° 31.302'	43° 08.933'
10.	Rioni	Rioni	Alpana	42° 33.736'	42° 50.536'
11.	Rioni	Tskhenistskali	Lentekhi	42° 46.972'	42° 43.335'
12.	Rioni	Tskhenistskali	Luji	42° 49.605'	42° 57.119'
13.	Rioni	Koruldashi	Tsana	42° 52.947'	43° 08.713'
14.	Enguri	Enguri	Vichnishi	42° 56.510'	42° 54.218'
15.	Enguri	Enguri	Mestia upper	43° 04.523'	42° 44.876'
16.	Enguri	Dolra	Ushkhvani	43° 02.671'	42° 36.143'
17.	Enguri	Nakra	Nakra Water intake	43° 04.184'	42° 22.822'
18.	Enguri	Nenskra	Kvemo Marghi	43° 01.100'	42° 11.403'
19.	Enguri	Enguri	Potskho-Etseri	42° 43.774'	42° 01.727'
20.	Enguri	Enguri	Khaishi	42° 56.693'	42° 10.692'
21.	Enguri	Chanistskali	Jikhashkari	42° 29.785'	42° 01.507'
22.	Enguri	Chkhoushia	Zugdidi	42° 29.428'	41° 50.793'
23.	Enguri	Jumi	Darcheli	42° 25.800'	41° 40.852'
24.	Enguri	Enguri	Anaklia Confl. Black Sea	42° 23.535'	41° 33.614'
25.	Enguri	Khobistskali	Gamogma Sua Khorga *	42° 16.371'	41° 50.293'
26.	Enguri	Khobistskali	Khobi	42° 18.804'	41° 54.586'

* Khobistskal is independently attached to the Black Sea

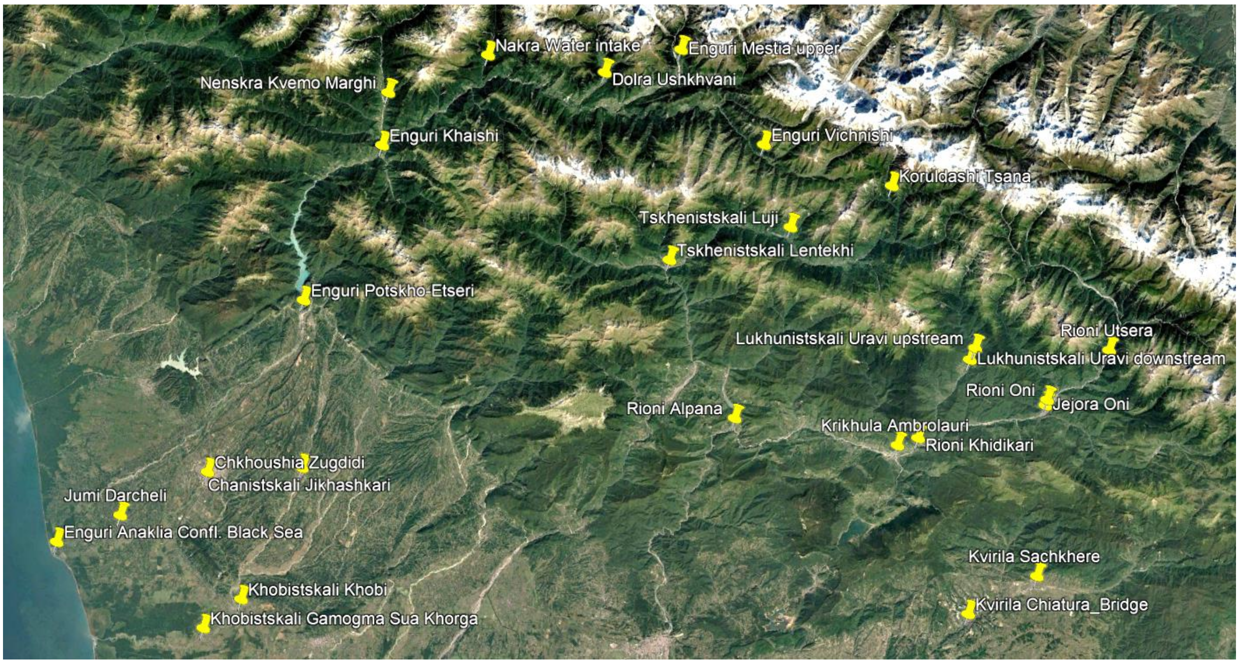

Figure 1: Map of sampling sites.

1.3. Pressure sources selected for the investigative monitoring

This section describes the main pressures within the Enguri-Rioni river basin.

The information was collected during the sampling campaign. Table 3 provides a list of major enterprises in the basin, which discharge industrial wastewater to the waterbodies. The table does neither include any information on the proportion of untreated waters discharged to the rivers and nor if there are biological treatments that are necessary for such activities.

Total pressures on rivers can be caused by various factors. For example:

- Kvirila Sachkhere, River Jejora and Rioni Oni, Lentekhi Tskhenistskali, Krikhula Ambrolauri, Jumi Darcheli, Anaklia Enguri, Chkhousia Zugdidi, Khobistskali Khobi, it is possible to be a settlement.
- Chiatura Kvrila - it is possible to be industrial activities in the municipality;
- Luji - Tskhenistskali river and Tsana in Koruldashi as well as Lukhunistskal river; it is possible to be the former arsenic factory;
- Rioni Alpana it is possible to be different activities (Hydropower, mining), which are located nearby;
- rRivers Nankra, Nenskra Mestiachala - it is possible to be nearby hydroelectric power stations;
- Enguri Potskho Etseri it is possible to be Enguri Reservoir;
- Rioni Utsera and Khidikari, Enguri Vichnishi, Enguri Khaishi, Chanistskali Jikhashkari: Total pressures can be due to various factors.

An overview of pressures is given in Table 4.

Table 3: Major enterprises in the basin.

Name of entrepreneur	Activity	Water object wastewater is discharge in
Chiatura Manganese	Manganese ore extracted	Riv. Kvirila
Former arsenic factory	Arsenic extracted	Riv.Lukhunistskali, Tskhenistskali, Koruldashi
Mestiachala Hydro	Hydro power	Riv.Mestiachala
Nakra and Nenskra hydro	Hydro power	Riv. Nakra and Nenskra
Alpana Hydro	Hydro power	Riv.Rioni
Enguri hydro	Enguri Resorvoir	Riv. Enguri
Unknown	Mining exraction	Rioni-Alpana
Kulevi Terminal	Oil Terminal	Khobistskali

Table 4: Characterisation of the sampling sites.

River basin	River	River type[1)]	Site	Nr	HMWB [2)]	Risk [3)]	Significant Pressure [4)]	Comment
Rioni	Kvirila	1 rt	Sachkhere	01	No	NR	N	
Rioni	Kvirila	1 rt	Chiatura_Bridge	02	Yes	R	P, T, H, O	
Rioni	Jejora	1 rt	Oni	03	No	Nr	N	
Rioni	Rioni	0 BS	Oni	04	No	RP	N	5)
Rioni	Rioni	0 BS	Utsera	05	No	RP	N	5)
Rioni	Lukhunistskali	1 rt	Uravi_Up stream	06	No	RP	N	6)
Rioni	Lukhunistskali	1 rt	Uravi Down stream	07	Yes	R	H, O	7)
Rioni	Rioni	0 BS	Khidikari	08	No	NP	N	
Rioni	Krikhula	1 rt	Ambrolauri	09	yes	R	P, T, H, O	
Rioni	Rioni	0 BS	Alpana	10	Yes	R	H, O	
Rioni	Tskhenistskali	1 rt	Lentekhi	11	Yes	R	P, T, H, O	
Rioni	Tskhenistskali	1 rt	Luji	12	Yes	R	P, T, H, O	
Rioni	Koruldashi	2 rt	Tsana	13	Yes	R	P, T, H, O	
Enguri	Enguri	0 rt	Vichnishi	14	No	NR	N	
Enguri	Mestiachala	2 rt	Mestia upper	15	Yes	R	H,O	
Enguri	Dolra	1 rt	Ushkhvanari	16	No	NR	N	
Enguri	Nakra	1 rt	Nakra Water intake	17	Yes	R	H, O	
Enguri	Nenskra	1 rt	Kvemo Marghi	18	No	NR	N	
Enguri	Enguri	0 rt	Potskho-Etseri	19	Yes	R	H,O	
Enguri	Enguri	0 rt	Khaishi	20	No	PR	H,O	
Enguri	Chanistskali	1 rt	Jikhashkari	21	No	NR	N	
Enguri	Chkhoushia	2 rt	Zugdidi	22	Yes	R	P,H, O	
Enguri	Jumi	1 rt	Darcheli	23	No	NR	N	
Enguri	Ganmukhuri bridge	0 rt	Anaklia Confl. Black Sea	24	No	NR	N	
Enguri	Khobistskali	0 BS	Gamogma Sua Khorga	25	No	NR	N	
Enguri	Khobistskali	0 BS	Khobi	26	No	NR	N	

1) 0 = the main river joins the Black Sea, 1 = The first major tributary of the main river, 2 = A second-order tributary of the main river, rt = row tributary, BS = the main river joins the Black Sea

2) Assignment as provisional HMWB: yes / no

3) Assignment of the risk status: R = at risk, PR = possibly at risk, NR = not at risk

4) Significant pressure: N = no significant pressure, P = organic pollution, E = eutrophication, T = toxic impact, H = hydro-morphological alterations, M = multistressor, O = other, U = unknown

5) A cascade of the Oni hydroelectric station is planned

6) A hydroelectric station is planned

7) An arsenic processing deposit is located here, the construction of a hydroelectric power station is planned

The delineation of SWB is done separately, therefore no SWB can be provided at this stage. The designation of HMWB was done preliminarily based on risk and hydromorphological pressure.

2. Methods

2.1. Characterization of conditions during the sampling period

The sampling was carried out 26th September and 01 October of 2022. The survey in the Rioni-Enguri basin was partly done by national experts unassisted and partly together with foreign experts. Table 5 presents the list of sampling dates and time as well as the experts involved. Furthermore, it covers a brief description of the general meteorological and hydrological conditions during the field work. The hydrological conditions during the sampling are summarised in Table 6. They are based on measurements using a hydrometric current meter.

Table 5: Sampling dates and information on meteorological (Met) and hydrological (Hyd) conditions.

Sample No.	River basin	River	Site	Date	Time	Team	Met	Hyd	Elevation (m asl)
1	Rioni	Kvirila	Sachkhere	26.09.2022	12:20/12:40	GS AG IK GG	Dry	Medium	425
2	Rioni	Kvirila	Chiatura_Bridge	26.09.2022	14:20/14:45	GS AG IK GG	Dry	low	331
3	Rioni	Jejora	Oni	26.09.2022	18:10/18:35	GS AG IK GG	Dry	Medium	787
4	Rioni	Rioni	Oni	26.09.2022	18:50/19:40	GS AG IK GG	Dry	Medium	795
5	Rioni	Rioni	Utsera	27.09.2022	10:40/11:10	GS IK GG	Dry	Medium	1003
6	Rioni	Lukhunistskali	Uravi_Up stream	27.09.2022	12:20/12:55	GS IK GG ZJ P D	Dry	Medium	891
7	Rioni	Lukhunistskali	Uravi Down stream	27.09.2022	13:55/14:10	GS IK GG ZJ P D	Dry	Medium	860
8	Rioni	Rioni	Khidikari	27.09.2022	15:40/16:10	GS IK GG ZJ P D	Dry	Medium	605
9	Rioni	Krikhula	Ambrolauri	27.09.2022	17:10/17:40	GS IK GG ZJ P D	Dry	low	565
10	Rioni	Rioni	Alpana	28.09.2022	11:10/11:20	GS IK GG ZJ P D	Dry	Medium	390
11	Rioni	Tskhenistskali	Lentekhi	28.09.2022	12:50/13:30	GS IK GG ZJ P D	Dry	Medium	725
12	Rioni	Tskhenistskali	Luji	28.09.2022	14:30/15:10	GS IK GG ZJ P D	Dry	Medium	1115
13	Rioni	Koruldashi	Tsana	28.09.2022	16:45/17:30	GS IK GG ZJ P D	Dry	low	1795
14	Enguri	Enguri	Vichnishi	29.09.2022	10:20/10:50	GS IK GG ZJ P D	Dry	Medium	1701
15	Enguri	Mestiachala	Mestia upper	29.09.2022	12:20/13:30	GS IK GG ZJ P D	Dry	low	1530
16	Enguri	Dolra	Ushkhvanari	29.09.2022	14:45/15:20	GS IK GG ZJ P D	Rain	Medium	1342
17	Enguri	Nakra	Nakra Water intake	29.09.2022	16:30/16:55	GS IK GG ZJ P D	Drizzle	low	1114
18	Enguri	Nenskra	Kvemo Marghi	29.09.2022	18:20/18:50	GS IK GG ZJ P D	Drizzle	Medium	776
19	Enguri	Enguri	Potskho-Etseri	30.09.2022	9:20/9:50	GS IK GG	Dry	low	265
20	Enguri	Enguri	Khaishi	30.09.2022	12:30/12:45	GS IK GG	Dry	Medium	560
21	Enguri	Chanistskali	Jikhashkari	30.09.2022	15:00/15:30	GS IK GG	Dry	Medium	90
22	Enguri	Chkhoushia	Zugdidi	30.09.2022	16:10/16:30	GS IK GG	Dry	low	70
23	Enguri	Jumi	Darcheli	30.09.2022	18:35/18:50	GS IK GG	Dry	Medium	7
24	Enguri	Enguri	Ganmukhuri bridge Anaklia Confl. Black Sea	01.10.2022	15:00/16:00	GS IK GG	Dry	low	1
25	Enguri	Khobistskali	Gamogma Sua Khorga	01.10.2022	17:20/17:50	GS IK GG	Dry	Medium	4
26	Enguri	Khobistskali	Khobi	01.10.2022	18:35/18:55	GS IK GG	Dry	Medium	15

Table 6: Water discharge and flow morphometric parameters measured in the field.

Results of water consumption and morphometric parameters measured at the points during the study period								
Site No.	DATE	TIME	RIVER NAME	WATER DISCHARGE	cross-sectional area	Average Velocity	River Width	Average depth
				Q, m³/s	F, m²	V, m/s	B, m	H, m
1	26.09.2022	12:20/12:40	River Kvirila - Sachkhere	4.45	6.62	0.67	19.0	0.35
2	26.09.2022	14:20/14:45	River Kvirila - Chiatura bridge	4.57	5.89	0.78	22.0	0.27
3	26.09.2022	18:10/18:35	River JeJora - Oni	7.70	7.52	1.02	15.0	0.50
4	26.09.2022	18:50/19:40	River Rioni - Oni	21.2	18.0	1.20	20.0	0.90
5	27.09.2022	10:40/11:10	River Rioni - Uwera	17.9	13.6	1.32	23.0	0.59
6	27.09.2022	12:20/12:55	River Lukhunistskali - Uravi Up Stream	3.69	3.96	0.93	11.4	0.26
7	27.09.2022	13:55/14:10	River Lukhunistskali - Uravi Down Stream	3.83	4.62	0.83	10.0	0.46
8	27.09.2022	15:40/16:10	Rioni - Xidikari	34.2	31.1	1.10	15.0	2.07
9	27.09.2022	17:10/17:40	Krikhula - Ambrolauri	0.62	1.54	0.40	7.00	0.22
10	28.09.2022	11:10/11:20	Rioni - Alpana	41.7	33.9	1.23	42.0	0.99
11	28.09.2022	12:50/13:30	Tskhenistskhali - Lentekhi	29.3	21.7	1.35	17.0	1.30
12	28.09.2022	14:30/15:10	Tskhenistskhali - Luji	11.9	11.3	1.05	26.0	0.44
13	28.09.2022	16:45/17:30	Koruldashi - Tsana	1.20	1.32	0.91	5.50	0.24
14	29.09.2022	10:20/10:50	Enguri - Vichnishi (1 stream)	6.20	5.76	1.07	16.0	0.36
			(2 streams)	0.78	1.26	0.62	6.50	0.23
			∑	6.98				
15	29.09.2022	12:20/13:30	Mesrtiachala - Mestia Upper (1 stream)	2.52	3.46	0.73	12.0	0.29
			(2 streams)	0.33	0.51	0.64	4.00	0.10
			(3 streams)	0.26	0.40	0.65	3.00	0.07
			∑	3.11				
16	29.09.2022	14:45/15:20	Dolra - Ushkhvanari	6.80	5.54	1.23	10.0	0.55
17	29.09.2022	16:30/16:55	Nakra - Water Intake	0.87	1.75	0.50	3.50	0.50
18	29.09.2022	18:20/18:50	Nenskra - Kvemo Marghi	18.5	12.8	1.45	18.0	0.71
19	30.09.2022	9:20/9:50	Enguri - Potskho-Etseri	3.24	11.3	0.29	31.0	0.36
20	30.09.2022	12:30/12:45	Enguri - Khaishi	55.2	36.6	1.51	35.0	1.05
21	30.09.2022	15:00/15:30	Chanistskhali - Jikhashkari	5.86	12.3	0.48	30.0	0.41
22	9/30/2022	16:10/16:30	Chkoushia - downstream zugdidi	1.10	1.96	0.56	14.0	0.14
23	9/30/2022	18:35/18:50	Jumi – Darcheli	4.50	8.00	0.56	24.0	0.33
24	10/1/2022	15:00/16:00	Enguri - Ganmukhuri bridge (near anaklia sea estuary) (1 stream)	4.82	23.3	0.21	100	0.23
			(2 stream)	1.04	2.5	0.42	30	0.08
			∑	5.86				
25	10/1/2022	17:20/17:50	Khobistskhali - Shua khorga	21.8	128	0.17	128	3.76
26	10/1/2022	18:35/18:55	Khobistskhali - Khobi	20.9	81.7	0.26	59	1.38

2.2. Quality elements

Three quality elements have been chosen:

- Macroinvertebrates (= macrozoobenthos) as biological quality element
- General physico-chemical parameters (no specific relevant pollutants such as heavy metals)
- Hydromorphology for site description

2.3. Responsibilities

Key responsibilities are summarised in Table 7.

Table 7. Responsibilities of the survey.

Responsibilities	Institution, contact person, email-address
General	National Environmental Agency
Responsible for the organisation of surface water body sampling	**Institution**: National Environmental Agency **Contact person** Gela Sandodze **E-Mail**: gela.sandodze@nea.gov.ge
Field work	
Responsible for field work (biological and chemical sampling, hydro-morphological site description)	**Institution**: National Environmental Agency **Contact person** Gela Sandodze **E-Mail**: gela.sandodze@nea.gov.ge
Responsible for functional check of sampling equipment	**Institution**: National Environmental Agency **Contact person** Gela Sandodze **E-Mail**: gela.sandodze@nea.gov.ge
Responsible for calibration of on-site measuring equipment	**Institution**: National Environmental Agency **Contact person** Gela Sandodze **E-Mail**: gela.sandodze@nea.gov.ge
Chemical analysis	
Overall responsible for the chemical analysis in the lab, including reporting and data delivery	**Institution**: National Environmental Agency **Contact person**: Lia Aptsiauri **E-Mail**: lia.aptsiauri@nea.gov.ge
Responsible for sample transport from the field to the laboratory	**Institution**: National Environmental Agency **Contact person** Gela Sandodze **E-Mail**: gela.sandodze@nea.gov.ge
Analysing laboratory and contact person	**Institution**: National Environmental Agency **Contact person**: Lia Aptsiauri **E-Mail**: lia.aptsiauri@nea.gov.ge
Biological analysis	
Overall responsible for the biological analysis in the lab, including reporting and data delivery	**Institution**: National Environmental Agency **Contact person**: Lia Aptsiauri **E-Mail**: lia.aptsiauri@nea.gov.ge
Responsible for field work (hydro-morphological site description) and Final hydromorphological report	**Institute:** National Environmental Agency **Contact person:** George guliashvili **E-Mail:** giorgi.guliashvili@nea.gov.ge

2.4. Sampling and field methods

Macroinvertebrates sampling was carried out following the AQEM-STAR multi-habitat sampling method. 20 subsamples per monitoring site were taken, each covering an area of 25*25 cm (0.5 mm mesh size). The replicate samples were selected after detailed habitat observation.

During the pre-treatment period of the samples and before tests were performed, each sample for **physico-chemical parameters** were kept according to the instructions, specific methodology and specific SOPs. In order to maintain integrity of the samples, keeping samples for a long period was avoided. At the same time, samples were kept in the proper condition of temperature and humidity. Before the analyses were done, the measurement and test equipment were calibrated internally by the laboratory staff.

During the **hydromorphological** research, the guidelines provided by international experts "General guidelines for surface water research" were used. During the field survey, the hydromorphological condition of each point was described, field survey protocols were filled, and river water flow was measured.

2.5. Laboratory analyses

2.5.1. Field parameters and transport

At each site the following parameters were measured: pH, electric conductivity, water temperature, dissolved oxygen and oxygen saturation. Chemical analyses of other parameters were carried out in the laboratory.

Samples were preserved separately at the site in accordance with the ISO standard cooled at 4 °C where it was necessary and transported to the laboratory.

2.5.2. Receipt of samples in the Laboratory

Samples were received in the laboratory by the analyst, which is, in this case, also the sample custodian on 14.11.2022; 03.10.2022. The sample custodian received the samples in the sample storage room and first of all carried out a qualitative check of each sample and of the accompanying documents, as for example:

- The integrity of the sample (well packed, the whole quantity inscribed in the sample protocols);
- The integrity of the label and of the information written on the label;
- The concordance of the information written on the label and the information recorded in the sampling protocols.

The protocols for sample delivery and handover are presented in Annex 7.

2.5.3. Handling of samples

During the period of pre-treatment of the samples and the performance of the tests, samples were handled in accordance with the instructions from the test method and the specific SOPs. In order to maintain integrity of the samples, long periods of keeping the sample in the laboratory are avoided. At the same time, samples were kept in proper condition of temperature and humidity.

Before the analyses were done the measurement and test equipment was calibrated internally by the laboratory staff.

2.5.4. Overview of analysed parameters

Analyses of the samples were done in accordance with the ISO standards and the appropriate SOP's which are implemented in the laboratory. A list of methods is given in the.

The parameters WT, DO, O2-Sat, pH and EC were analysed both in the field and in the laboratory.

Ion-chromatography-ICS 1000, spectrophotometer-HITACHI U-2900 and titrimetric methods were used to conduct chemical analyses. The LOD of the determined parameters is given in Table 8.

Table 8: Parameters analyzed in the field and in the laboratory.

Parameter	Unit	LOD	Standards
Suspended Solids	mg/l	0.8	ISO 11923:2007
BOD_5	mg/l	0.75	ISO 5815-1:2010
COD	mg/l		ISO 6060:2010
Ammonia	mgN/l	0.05	ISO 7150-1:2010
Nitrite	mg/l	0.001	ISO 10304-1:2007
Nitrate	mg/l	0.001	ISO 10304-1:2007
Phosphate	mg/l	0.001	ISO 10304-1:2007
Sulphate	mg/l	0.001	ISO 10304-1:2007
Chloride	mg/l	0.001	ISO 10304-1:2007
Potassium	mg/l	0.002	ISO 11885:2007
Sodium	mg/l	0.001	ISO 11885:2007
Calcium	mg/l	0.5	ISO 6058:2008
Magnesium	mg/l	0.5	ISO 6058:2008
Total phosphorus	mg/l		Ю.Ю. Лурье ”Унифицированные методы анализа вод” [Unified methods of water analysis]

2.6. Quality assurance

Sampling AQC's were made in accordance with the contract (contractor demand).

The laboratory uses reference materials. All standard solutions were prepared from reference materials which are labelled with the date of preparation, expiry date and the name of person that prepared the solution. These solutions are kept in conditions specified in the test method.

2.6.1. Problems, difficulties and deviation from the work plan

There were several difficulties to take samples. For example, inititially it was planned to sample the Khobistkali at Kulevi. However, the area was restricted due to being located in an industrial port – the Kulevi oil terminal. Therefore, the sample was taken at a different location Gamogma shua Khorga.

Site Chiatura Kvirila was located near a dam. Therefore, the sample was taken at a different location (a few hundred meters away).

2.6.2. Biological analyses

2.6.2.1. Field work

Field work followed the standard multi-habitat sampling (MHS) method as defined by the EU projects AQEM/STAR and described in the Survey Manual. At each site 20 sub-samples or replicates are taken from different habitats (= choriotopes). Each replicate represents a minimum areal proportion of 5%. Habitats with <5% areal proportion were not sampled. The habitats were documented in the AQEM/STAR template as prepared during the training prior to the survey.

Sampling of bottom sediment is carried out by setting down the MHS net downstream of the choriotope, which is then stirred up, to allow fine sediment and animals drifting into the net. The projected area of each choriotope is 25 x 25 cm, the total sampling area is 1.25 m^2.

2.6.2.2. Lab work

In the laboratory, a grid for selecting sub-samples as defined by the AQEM/STAR approach was used.

2.6.2.3. Identification keys

1. Aquatic insects of North Europe, volume I
2. Invertebrates systematique, Biology, Ecology, Henri Tachet, 3 pieces
3. The Mayflies of Europe (Ephemeroptera), Ernst Bauernfeind &Tomas Soldan
4. Mayflies, Naturalists, Handbooks 13. Janet Harker
5. Family level key to the stream invertebrates of Maryland and surrounding areas, third edition August 2003. Maryland Department of natural resources
6. Определитель пресновомных беспрзвоночных Европейсской части СССР. Ленинград, 1977 [Identification of freshwater invertebrates of the European part of the USSR. Leningrad, 1977]

3. Results

3.1. Field protocols and hydro-morphological site description

The field protocols are presented in Annex 2, Annex 3 includes the protocols of the hydro-morphological site description.

Site Number 1 - Kvirila Sachkere - The section of Kvirila Sachkhere has changed slightly hydromorphologically, there are dams on the bank. The banks are stabilized. Bed elements is found bars, islands, Riffles/Rapids. Bed substrates is found boulder, cobbles, Gravel/Pebble, sand, coarse debris, Silt/mud, clay. Flow Types found were chute, broken standing waves, unbroken standing waves, rippled, no perceptible flow. Bank stabilization types found was concrete.

Site Number 2 – Kvirila Chiatura Bridge – the section of Kvirila Sachkhere The place has been greatly modified by human activity. The place is surrounded by dams. It is an eroded area. 0.5 km from the survey point there is a dam where water is collected and fish migration is prevented. As a result of manganese mining, dirty water flows directly into the river Khvrila, polluting it. The mentioned area is facing an ecological disaster. Bed elements are bars and riffles. Typical bed substrates is cobble, gravel/pabble, sand, coarse debris, silt/mud, and clay. Flow types is found Broken standing waves, unbroken standing waves, Rippled, No perceptible flow. Bank stabilization types is concrete and brickwork/boulders.

Site Number 3 – JeJora Oni - It is located in the city of Oni. Intensive erosion processes are observed on both banks of the river. On the left bank of the river, a concrete anti-erosion wall has been built. Bed elements are bars, riffles/rapids, and step pool sequence. Bed substrates include cobbles, gravel/pabble, sand, coarse debris, silt/mud. Flow types found are chute, broken standing waves, unbroken standing waves, chaotic, no perceptible flow. Bank stabilization types found: concrete.

Site Number 4 – Rioni oni - It is located in the city of Oni. At the research point, erosion processes are active on both banks of the river, so gabions are installed. Household water is discharged into the river by the population. The river is planned in this area. The construction of the cascades of the Oni hydroelectric station in Rioni, which poses a risk from the hydromorphological point of view. Bed elements is found bars, riffles, step pool sequence. Bed substrates is found boulder, cobble, gravel/pebble, sSand, coarse debris, Silt/mud. Flow Types is found chute, broken standing waves, unbroken standing waves, no perceptible flow. Bank stabilization types is found concrete, boulders, gabions.

Site Number 5 – Rioni Utsera - At the research point, erosion processes are active on both banks of the river, so gabions are installed. Due to erosive processes, the river is undermining the central highway. Household water is discharged into the river by the population. The river is planned in this area. The construction of the cascades of the Oni hydroelectric station in Rioni, which poses a risk from the hydromorphological point of view. Bed elements is found bars, Island, Riffles, step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, Silt/mud. Flow Types is found Chute, Broken standing waves, unbroken standing waves, No perceptible flow. Bank stabilization types is found Concrete, boulders, gabions.

Site Number 6 – River Lukhunistskhali Uravi Up Stream It is located in the upper part of Uravi village. The research point is in a natural state, there are no traces of anthropogenic intervention. Erosive processes are active. During the field research, it was established that the construction of a new hydroelectric power plant has started about 100 meters below this point, which will completely change the hydromorphological and hydrological regime of this point. Bed elements is found Riffles, step pool sequence, rocks, Rapid. Bed substrates is found bedrock, boulder, Cobble, Gravel/Pabble, Sand, coarse debris. Flow Types is found Chute, chaotic, Broken standing waves, unbroken standing waves, No perceptible flow. Bank stabilization types is found Concrete, boulders, gabions.

Site Number 7 – River Lukhunistskhali Uravi Up Stream - At the base of the Lukhun arsenic deposit, village The Racha metallurgical plant is operating in Uravi, which creates an ecological threat. Erosion processes are active in the research point, artificial structures concrete gabion can be found in the bed. It is planned to build a hydroelectric power plant in the Upper Bief. Bed elements is found Riffles, islands, bar, step pool sequence, rocks. Bed substrates is found bedrock, boulder, Cobble, Gravel/Pabble, Sand, coarse debris. Flow Types is found Chute, Broken standing waves, unbroken standing waves, No perceptible flow. Bank stabilization types is found Concrete, boulders, gabions.

Site Number 8 – River Rioni Khidikari It is located in the Khidikari narrows, erosion processes are active in this section. Bed elements is found bar, Riffles, islands, step pool sequence, rocks. Bed substrates is found bedrock, boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found rippled, unbroken standing waves, No perceptible flow.

Site Number 9– River Krikhula Ambrlauri It is located in the center of Ambrolauri. The research point is completely changed. The bed is surrounded by buildings, the banks have a concrete structure. The waste water from the irrigation system flows directly into the river. The river bed and morphological characteristics have been completely changed. Bed elements is found bar, Riffles. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found rippled, unbroken standing waves, No perceptible flow. Bank stabilization types is found Concrete, boulders, gabions.

Site Number 10 – River Rioni Alpana It is located near Alpana village. Through field research, it was determined that a sand and gravel factory is operating in the vicinity of the research area. The river produces erosive actions. Water consumption was measured on the bridge in Alpana village. 0.5 km downstream from this bridge, the Rioni river joins the river. Flow of water produced by Lajanur HPP from Lajanura Basin. Bed elements is found bar, Riffles. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found rippled, unbroken standing waves, No perceptible flow. Bank stabilization types is found Concrete, boulders, gabions.

Site Number 11 – River Tskhenistskhali Lentekhi Located below Lentekhi, erosion processes are active in the mentioned section. This area has been hydromorphologically changed due to the road and infrastructure. In the last century, there was an arsenic processing deposit on Koruldash, a tributary of tskhenistskhali, which was closed and the tanks were buried in the ground. The river washed away the bottom and then it was placed in the sarcophagus, but the risk of erosive processes breaking it is high and arsenic getting into the river water. Bed elements is found Riffles, Island, Rapid, Rocks, Step pool sequence. Bed substrates is found bedrock, boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible flow.

Site Number 12 – River Tskhenistskhali Luji Located village Luji. Erosion processes are active in the mentioned section. This area has been hydromorphologically changed due to the road and infrastructure. In the last century, there was an arsenic processing deposit on Koruldash, a tributary of tskhenistskhali, which was closed and the tanks were buried in the ground. The river washed away the bottom and then it was placed in the sarcophagus, but the risk of erosive processes breaking it is high and arsenic getting into the river water. Bed elements is found Riffles, Island, Rapid, Rocks, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves.

Site Number 13 – River Koruldashi Located village Tsana. Erosion processes are active in the mentioned section. This area has been hydromorphologically changed due to the road and infrastructure. In the last century, there was an arsenic processing deposit on Koruldash, which was closed and the tanks were buried in the ground. The river washed away the bottom and then it was placed in the sarcophagus, but the risk of erosive processes breaking it is high and arsenic getting into the river water. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves.

Site Number 14 – River Enguri Vichnishi Located village Vichnishi. erosion processes are active in the mentioned section. The section of the central highway is being washed away. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible Flow. Bank stabilozation Types Boulders/Gabions.

Site Number 15 – River Mestiachala located Mestia upper. Erosion processes are active on the banks, the stream flows into several branches. An important intervention here is that upstream of the survey point, water is taken by the Mestiachala HPP, and drinking water is also taken by pipe for the entire population of Mestia. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible Flow. Bank stabilozation Types Boulders/Gabions.

Site Number 16 – River Dolra Located village Ushkhvanari. Erosion processes are active on the banks, the stream flows in one branch. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible Flow. Bank stabilozation Types Boulders/Gabions.

Site Number 17 – River Nakra Located village Nakra water intake. Erosion processes are active in the mentioned area. Water intake is done by the HPP and the amount of water in the bed is reduced. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible Flow. Bank stabilozation Types Boulders/Gabions.

Site Number 18– River Nenskra Located village Kvemo Marghi. Erosive processes are active. Roads and houses were flooded as a result of river overflow in the past years. Therefore, the river was turned into an artificially arranged bed between the gabions. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible Flow. Bank stabilozation Types Boulders/Gabions.

Site Number 19 – River Enguri Postkho Etseri Located down stream Jvari reservoir. Erosive processes are active. The hydromorphological conditions have changed, due to the water flow regulated by the reservoir, the morphometric and morphological characteristics of the water here have completely changed. Bed elements is found bar, Riffles, Island. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found rippled, Broken standing Waves, unbroken standing waves, No perceptible Flow.

Site Number 20 – River Enguri Khaishi Located Village Khaishi. The Cross Reservoir is located downstream from the mentioned point. Erosive processes are active. Bed elements is found Riffles, Island, Rapid, Step pool sequence. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found chute, rippled, Chaotic, Broken standing Waves, unbroken standing waves, No perceptible Flow.

Site Number 21 – River Chanistskhali Located village Jikshashkhari. The river is the right tributary of Khobisqali. Erosive processes are active. There is no significant pressure. Bed elements is found bar, Riffles, Island. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found rippled, unbroken standing waves, No perceptible Flow. Bank stabilization types Boulders/Gabions, Concrete.

Site Number 22 – River Chkoushia Down stream zugdidi Located down city Zugdidi. In the mentioned area, human intervention is important, erosion processes are active, sewage water enters the river directly through the pipe and pollutes it. Dams have been built on the banks, hydrological and morphological parameters have been changed. Bed elements is found bar, Riffles, Island. Bed substrates is found boulder, Cobble, Gravel/Pabble, Sand, coarse debris, clay, silt/mud. Flow Types is found rippled, unbroken standing waves, No perceptible Flow. Bank stabilization types Boulders/Gabions, Concrete.

Site Number 23 – River Jumi located village Darcheli. Erosive processes are active in the mentioned section. There are earth dams on the banks, which protect the surrounding area from flooding. Bed elements is found bar, Riffles. Bed substrates is found Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found rippled, unbroken standing waves, No perceptible Flow. Bank stabilization types Land gabion.

Site Number 24 – River Enguri Ganmukhuri bridge located Anaklia. Erosive processes are active in the mentioned section. During the flood period, the flow of water overflows from the banks and fills the space. Bed elements is found bar, Riffles, island. Bed substrates is found Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found rippled, unbroken standing waves, No perceptible Flow.

Site Number 25 – River Khobistskhali Shua Khorga located near khorga. During the flood period, the flow of water overflows from the banks and fills the space. Erosive processes are active. Bed elements is found bar, Riffles, island. Bed substrates is found Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found rippled, unbroken standing waves, No perceptible Flow.

Site Number 26 – River Khobistskhali Khobi located city khobi. During the flood period, the flow of water overflows from the banks and fills the space. Erosive processes are active. Bed elements is found bar, Riffles, island. Bed substrates is found Cobble, Gravel/Pabble, Sand, coarse debris, clay. Flow Types is found rippled, unbroken standing waves, No perceptible Flow.

3.2. Chemical analyses

Analytical samples were brought to the laboratory on October 10, 2022, the analyses started on the same day. The results of the determined parameters were compared with the Approval of Technical Regulations for Protection of Surface Water Pollution in Georgia (Government of Georgia Resolution # 425 December 31, 2013 Tbilisi). The maximum allowed concentrations are given along with the analytical results in Annex 3a. A summary table is provided as Annex 3b.

20 chemical parameters were determined in 26 rivers of Rioni-Enguri basin. The include physico-chemical parameters measured in the field, BOD_5, COD, main ions, nutrients as well as ammonium and nitrite as indicators of organic pollution.

The studied rivers are normally mineralized rivers with a range of total mineral content of 59.3 to 358 mg/l.

Biogenic compounds are within acceptable limits, except for ammonium at site 2 (Kvirila-Chiatura_Bridge), 15 (Mestiachala-Mestia upper), 19 (Enguri-Potskho-Etseri), 20 (Enguri-Khaishi), and 22 (Chkhoushia-Zugdidi). Especially at Kvirila-Chiatura_Bridge, NH_4-N concentration was very high (>3.8 mg/l) and coincided with an exceptionally high concentration of suspended solids (>5900 mg/l). These values indicate local sources of pollution, possibly also a chemical accident.

The deviation of pH values from the permitted range (6.5–8.5) is difficult to explain; some values reach pH 10 (Mestiachala-Mestia upper), at one site (Enguri-Potskho-Etseri) a pH of 5.9 was measured. Methodological problems with the field probe cannot be excluded in these cases.

All other measured values are within acceptable limits. In Annex 3b, exceedance of the MPC of ammonium and the deviations from the permitted range (pH) are highlighted in yellow.

3.3. Biological data

Identified data of macroinvertebrates were collated in an Excel file and prepared to be used by Asterix software for biological index calculation. The calculation itself was not carried out so far. The raw data are presented in Annex 6. The table includes taxa names and ID (AQEM codes).

Total taxa richness over all 26 sites was 50, taxa richness per site varied between 0 and 14 (Figure 2). Abundance varied between 0 and 1172 individuals per sample (Figure 3). As can be seen from Figure 4, these two metrics significantly correlate (pearsson correlation coefficient $r = 0.43$, $p = 0.027$). It can be derived from this finding that human pressure affects not only biodiversity but is also responsible for a lower abundance of benthic invertebrates, which can have negative consequences for self-purification processes.

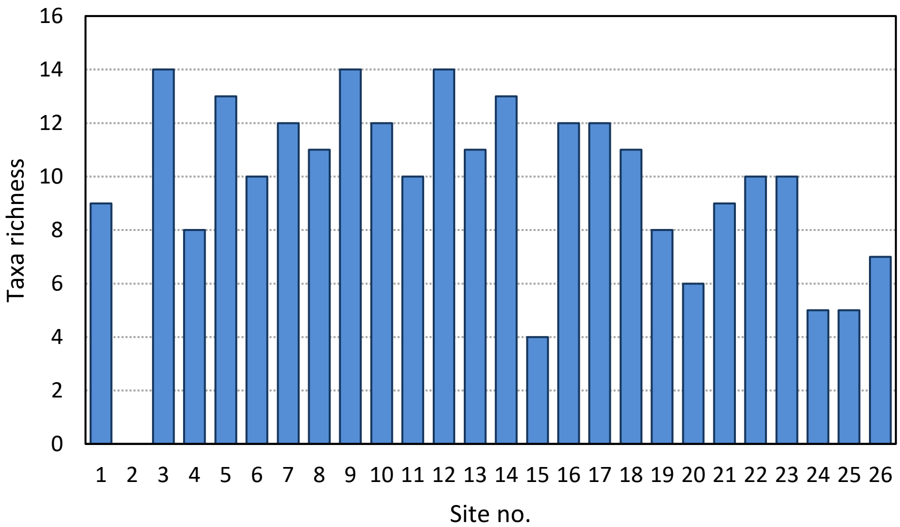

Figure 2. Taxa richness of benthic invertebrates.

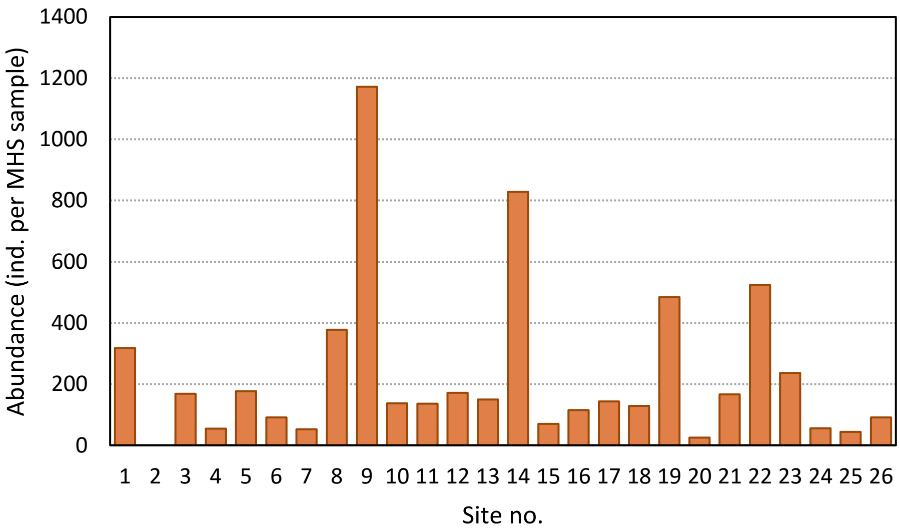

Figure 3. Abundance of benthic invertebrates.

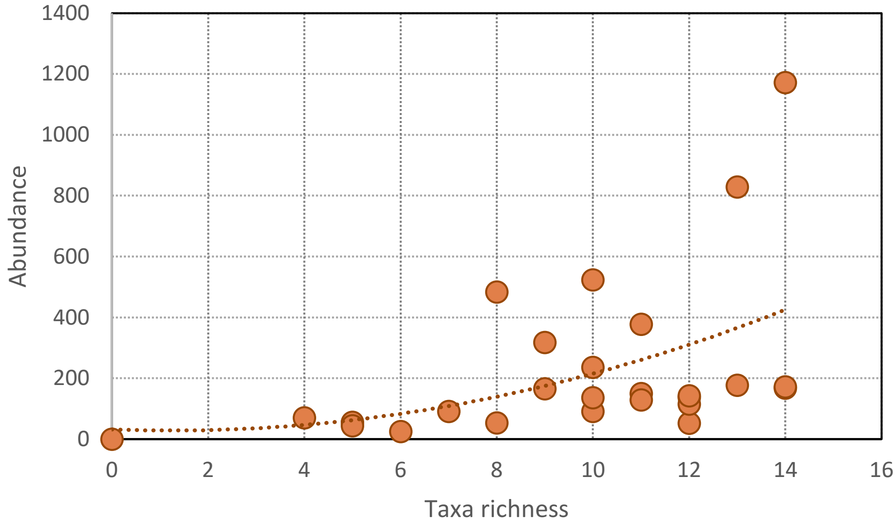

Figure 4. Correlation of taxa richness and abundance of benthic invertebrates.

As we see on the sites, there are many different pressures like, mining, organic pollution, hydro-power stations, and water extraction from irrigation. For example, at sampling site Kvirila Chiatura no invertebrates were found at all. A plausible reason for this is the mining activities upstream of this site, which result also in high concentrations of suspended solids, ammonium, and sulphate. At Khrykhula Ambrolauri site, taxa richness of macroinvertebrates was high despite obvious organic pollutionas identified in the field (but not indicated by the chemical analyses).

Khobistskali-Khobi sampling site is characterized by hydrological and organic pressure, again identified at the sampling site but hardly seen in the physico-chemical or biological data. It must be assumed that single measurements do not sufficiently cover occasional peaks of pressure.

Besides the anthropogenic impact, the taxonomic composition of the benthic invertebrates shows differences between river types. In the lowland river sites (e.g. Khobistskali, Jumi-Darcheli, Enguri-Anaklia Confl. Black Sea), a high proportion and taxa richness of molluscs and oligochaetes were found. In contrast, the several mountain rivers were characteised by a diverse assemblage of EPT taxa (Ephemeroptera, Plecoptera, Trichoptera) and other rheophil forms such as blepharicerids.

4. Conclusion

This report summarises the results of a campaign carried out between 26th September and 2nd October 2022 at 26 sampling sites in the Rioni-Enguri river basins. In summary, anthropogenic impacts are clearly visible in the studied river basins. Due to the construction of irrigation systems, the rivers in the Rioni-Enguri basin have changed significantly and differ from their natural state. The morphological change of rivers due to hydroelectric power plants is well illustrated in Khurila – Chiatura, Lower Lukhumistskal, Korulda – Tsana, Krikhula – Ambrolauri, Mestiachala – Upper, Nakra – below water intake, Enguri Potsho Epseri, Chkhousia – Zugdidi. The valleys of the study areas have been completely changed for energy, drinking, and irrigation purposes. Sewage effluent remains a major pollutant in water bodies. Sand-gravel mining enterprises systematically extract inert material from the riverbed, resulting in the formation of trenches in the riverbed, swamp, and completely changing the riverbed and bed processes. Arsenic processing plants pollute waters. It should be noted that the amount of water in the lower rivers decreases due to water extraction and water consumption.

Any type of impact on river channels, such as water withdrawals for irrigation or power plants, changes the natural state of rivers. Therefore, during any such intervention, it is necessary to take into account the knowledge of experts in order to minimize the damage to the morphological characteristics of the river. This report provides information on the hydromorphology, physico-chemical situation and biological condition. A final assessment of the ecological status cannot be provided so far, partly because the surface water body delineation is still under development, partly because the methods developed in other river basins (e.g. Alazani) cannot directly be adopted to the Rioni-Enguri river basin. The biological assessment will be carried out later based on various indices. It is intended to pave the way towards a WFD compliant assessment of ecological status in the rivers studied.

Despite of the preliminary state of data evaluation and assessment, the results indicate a significant organic or pollutant load in some of the rivers studied. Noteworthy is the exceedance of the limit values (MPC) for ammonium in some cases (especially at Kvirila-Chiatura_Bridge, along with very high turbidity), which resulted in a complete loss of colonisation by benthic invertebrates.

In the majority of rivers, however, water quality seems good and various benthic invertebrate taxa were found. This can be derived from the diverse benthic fauna found in several mountain streams (various rheophil forms such as EPT taxa and blephariceridae).

5. Annexes

Annex 1: Field protocols (scans)

Annex 2: Hydro-morphological site description (Scans)

Annex 3a: Chemical analyses (in Word format)

Annex 3b: Chemical data summary (in Excel format)

Annex 4: Protocol for sample handover (Scans)

Annex 5: Water quality norms [in Georgian]

Annex 6: Biological data summary (in Excel format)

Annex 7: MHS field tables

Annex 8: Metadata

Annex 9: Photo documentation

Annexes are available as separate documents

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