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Results of the monitoring of macroinvertebrates and juvenile fish and practical sessions in 2018

Final Report

Kyiv 2018

Document verification

Document title		Results of the monitoring of macroinvertebrates and juvenile fish and practical sessions in 2018
Revision	**Date**	**Authors**
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Introduction

The surveys in spring 2018 are conducted as a part of the post-commissioning monitoring of Dariali HPP in accordance with the requirements stated in the report *"Aquatic biodiversity: monitoring results in 2016 and mitigation measures proposed"* (2017). The surveys concern aquatic biodiversity only.

The goal of the post-commission monitoring is to assess the impact of the HPP operation at aquatic biodiversity as well as to conduct trainings on monitoring of aquatic diversity and habitat and flow monitoring with the final goal to ensure hand-over of the monitoring to Georgian trainees.

The surveys were conducted in period from 28th of April to 2nd of May 2018. The training on aquatic biodiversity monitoring was conducted from 29th of April to 2nd of May 2018 in parallel to the surveys. The training on monitoring of river channel, depths, sediments and mapping was conducted on 29th of April 2018.

1. Results of aquatic biodiversity monitoring

1.1 Results of the monitoring of juvenile fish

The start of spring migration is in second half of March and it lasts to August with different intensity. During this period, juvenile trout downgrades from spawning grounds located in upper reaches of Tergi, including upstream the Dariali HPP. The most intense downgrading migration is from the end of March to the mid-April. Fish can downgrade through the dike of the Dariali HPP by two ways: through fish pass and sluice for washing. Besides, part of juvenile fish can enter sand traps.

Control of downgrading juvenile fish was done using cone net at the outlet from the fish pass. Besides, in order to assess if fish can possibly enter HPP turbines, the downgrading fish was monitored at the entrance to the sand trap. Researches were conducted during day and night times. The trap was installed for 5-15 min during the day each 3 hours (Figures 1 - 3).

Figure 1. Installment of the fish trap

Figure 2. Checking fish trap

In addition, using ichthyological net, the waters along the banks of water reservoir was surveyed.

Results of monitoring showed that there were no downgrading juvenile fish at the outlet from the fish pass and at the entrance to the sand trap in the studied period.

Survey using ichthyological net around the water reservoir showed the presence of juvenile trout with the length up to 2 cm, which form small groups of 3-6 species in relatively shallow part of water reservoir at right bank of Tergi. It avoids any traps and capable to fight with the flow.

Figure 3. Traps for downgrading fish

Conclusion: Absence of downgrading juvenile trout in the fish pass and in the sand traps in 2018 as well as 2017 can be explained by favorable conditions for it in the water reservoir, so it prefers not to go down more.

1.2 Results of water invertebrates' monitoring

The main goal of the water invertebrates' surveys was to assess the changes in status of Tergi river using biological indication after 6 months of its operation. The monitoring was conducted at four stations, established earlier (Table 1).

Table 1. Monitoring stations for water invertebrates

№	Monitoring station	Invertebrates monitoring
M 1	Tergi upstream the Dariali headworks	+
M 2	Tergi downstream the Dariali headworks (boulder section)	+
M 3	Tergi downstream the Dariali headworks (braided section)	+
M 4	Tergi downstream the Dariali headworks (single thread section)	+

M 1 - Tergi upstream the Dariali headwork

At this station, there is riparian-meadow plants. Algae are presented by some *Bacillariophyceae* and *Chlorophyta*, out of microalgae there are *Hydrurus foetidus*. This corresponds to the previous our studies.

The structure of the bottom biotsenosis includes mainly imago of *Drusus caucasicus* (up to 10-30 species per 15 cm^2), *Chironomidae* (30%). There were mass of *Gammaridae* and much less imago of *Ephemeroptera*, *Plecoptera* as well as *Diptera* (5-14%)

Express assessment by hydrobiological parameters showed that TBI and BBI indexes have 9 scores, corresponding to the water quality "clean".

M 2 - river Tergi, downstream the Dariali headwork (boulder section)

At this station, there is only riparian-floodplain vegetation with bushes, sea-buckthorn, barberries and dog rose. There were a few *Fontinalis sp.* Algae are represented by *Bacillariophyceae* and *Chlorophyta*, *Hydrurus foetidus.*

Macroinvetebrates' communities at this station at all years were characterized by the least abundance. The same situation is observed in 2018. The structure of biotsenosis includes mainly imago of *Chironomidae* and *Ephemeroptera,* there are a bit few imagoes of other *Diptera*; all other groups were very few in numbers. Such low diversity can be explained by morphological peculiarities: reduction of the length of riverbed, inclination, high velocity, which create difficult habitats for the majority of invertebrates.

Express assessment by hydrological parameters showed that TBI and BBI indexes have 8 scores, corresponding to the water quality "clean".

It is worth to mention that comparing with the previous years, the state of the river at this station is improved due to stabilization of conditions after finishing the Dariali HPP construction.

M 3. Tergi downstream the Dariali headworks (braided section)

The riparian plants are represented by sea-buckthorn, barberries and dog rose. Water plants are represented by moss *Fontinalis sp.* in the riverbed. Algae are represented by a few Bacillariophyceae; the share of *Chlorophyta* and *Hydrurus foetidus* is increased.

The structure of the bottom biotsenosis at this station includes mainly *Chironomidae* and *Ephemeroptera*, but the share of *Plecoptera* and *Tricoptera*. gets increased; there were a few of other *Diptera*.

Express assessment by hydrological parameters showed that TBI and BBI indexes have 8 score, corresponding to the water quality "clean".

Comparing to the previous years, the abundance and diversity of macroinvertebrates get increased, which shows the improvement of the ecological situation in general due to reduction of flow velocity and increase of habitats diversity with the reduction of the share of boulders.

M 4. Tergi downstream the Dariali headworks (single thread section)

This monitoring station is characterized only by riparian-meadow plants, there are a few of *Fontinalis sp.* Algae are represented by few colonies of *Bacillariophyceae* and *Chlorophyta*, out of microalgae there are colonies of *Hydrurus foetidus*.

The structure of biotsenosis includes mainly imago of *Chironomidae,* there are a bit few imago of *Ephemeroptera*; all other groups were very few in numbers.

Express assessment by hydrological parameters showed that TBI and BBI indexes have 9 scores, corresponding to the water quality "very clean".

Conclusions:

Species composition of bottom macroinvertebrates didn't change much comparing with 2016. In total, there are 90 species of invertebrates belonging to 18 groups (See Annex 1).

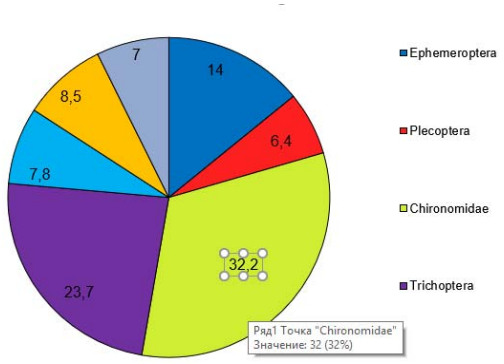

Figure 4. Composition of the Tergi river by groups of macroinvertebrates

By the results, the main group of invertebrates is *Chironomidae* – 32,2 % from the total number, *Trichoptera* – 23,7 %, *Ephemeroptera* – a bit more than 14,1 %, *Gammaridae* – 8,5%, *Diptera* – 7,8%, *Plecoptera* – 6,4%. The rest (7,3%) is shared between the following groups: *Nematoda, Nematomorpha, Oligochaeta, Ostracoda, Cyclopoida, Araneida, Acarina, Collembola, Heteroptera u Coleoptera, Lepidoptera, Simuliidae* (Figure 4).

In general, there is an increase of the values of bioindication indexes and indicators of abundance of bottom invertebrates observed comparing with the previous years. This shows the improvement of water quality and state of macroinvertebrates in post-commissioning period. Migration activity of the macroinvertebrates also corresponds to the level, fixed in the previous years of study. At present, stabilization of ecological conditions after the end of construction period did not lead to the changes in the structure of bottom habitats. In the same time, reduction of flow velocity supported the development of bottom invertebrates.

2. Conduction of trainings

2.1 Trainees

There were 4 trainees involved, which were identified by “Dariali Energy” company:

1. Archil Phartsvania
2. Marina Gioshvili
3. Eldar Kashia
4. Rostislav Skripachuk

2.2 Training on aquatic diversity monitoring

The training on aquatic diversity monitoring was conducted according to the plan, presented in the Table 2.

Table 2. Agenda of the training on aquatic diversity monitoring

Date	Type of activities	Location
28/04	Monitoring of downgrading juvenile fish	Sand traps in day time
	Monitoring of invertebrates	Station M 4
29/04	Monitoring of downgrading juvenile fish	Sand traps in night time
	Monitoring of invertebrates	Station M 3
	Practical session	How to monitor invertebrates M 3
	Practical session	Monitoring of river channel, depths, sediments and mapping
30/04	Monitoring of downgrading juvenile fish	Sand traps in day time
	Monitoring of invertebrates	Station M 2

Date	Type of activities	Location
	Practical session	How to monitor invertebrates M 2
1/05	Monitoring of downgrading juvenile fish	Sand traps in night time
	Monitoring of invertebrates	Station M 1
	Practical session	Monitoring of downgrading juvenile fish at sand traps at night
2/05	Monitoring of adult fish	Dariali dam
	Monitoring of invertebrates	Monitoring at multiarmed channel upstream Stepantsminda
	Practical session	Fish pass control. Methods of catchings, measurements of caught fish, fish tagging, fish trap placing etc

The trainings were united with the field work on monitoring of the experts to make them as practical as possible. The training on aquatic biodiversity included the sessions on macroinvertebrates' monitoring (Figure 5) and fish presence / fish pass monitoring (Figure 6).

Figure 5. Session on aquatic macroinvertebrates' monitoring

Figure 6. Session on the fish monitoring

The training on macroinvertebrates' monitoring included all four monitoring stations, established.

During the training participants got information to continue doing this monitoring in future by themselves and relevant hand-over certificate (Figure 7).

Figure 7. Example of the certificate obtained

After the end of training, there was discussion about methods of ecological monitoring, and recommendations were provided how to maintain fish pass constructions and ensure proper water levels.

Obtained knowledge by participants allow to manage HPP properly and ensure stable water level in the fish pass during spawning and downgrading of fish.

2.3 Training on monitoring of river channel, depths, sediments and mapping

On 29th of April 2018, a training on monitoring of the river channel, depth, sediment and mapping was conducted for above mentioned participants.

During training, trainees got to know rules and order of conduction of hydromorphological monitoring and last of monitoring stations, where monitoring should be conducted.

Before the start of field surveys, specialists were shown equipment needed for conduction of field surveys:

- Universal hydrometric current meter – for flow velocity measurement;
- Gauging rod – for measurements of water levels and flow depths;
- Large range finder – for distance and riverbed width measurements;
- Frame 1 m^2 - for visual assessment of the percentage composition of sediments;
- GPS 60C Garmin – for coordinates measurements;
- DJI Phantom 4 Advanced drone.

During the field session, experts showed how to measure depths and flow velocity at four cross-sections, and how to fill field protocol (Figure 7). At fifth cross-section, the measurements were done by Archil Phartsvania, Eldar Kashia and Rostislav Skripachuk. Marina Gioshvili and Archil Phartsvania got to know in detail assessment of the percentage composition of sediments.

After the end of field works, the experts showed the use of DJI Phantom drone for aerial images and further use of images for construction of maps of depths and velocities within monitoring stations.

The trainees got the list and principle of the use of all key software, needed for processing field data– Excel MS Office, ArcGis (QGis), DJI Go.

All participants of training got in electronic form the additional information for successful conduction of hydromorphological monitoring as well as templates of field protocols to be filled and examples how to build maps of depths and velocities.

Figure 8. Hydromorphological training

After the end of the training, trainees got certificates when they successfully passed the training (Figure 9). Now they got sufficient knowledge to do such a monitoring by themselves.

Figure 9. Example of the certificate obtained

3. Conclusions

Out of the assignment of spring 2018, the Consultant can make the following conclusions:

- No negative consequences of the Dariali HPP operation for aquatic biodiversity are observed during monitoring in spring 2018.

- The assessment of the state of Tergi by the composition of the main groups of invertebrates didn't show the deterioration of their communities.

- The handover procedure of the both types of monitoring: (i) aquatic diversity and (ii) monitoring of river channel, depths, sediments and mapping was successfully arranged for all the trainees in the end of the trainings. Conducted practical sessions allow trainees to conduct post-commissioning monitoring of the impact of Dariali HPP at aquatic diversity.

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Annex 1. Species composition of macroinvertebrates at monitoring stations in Tergi in spring 2018

Species	Sum	Monitoring stations			
		M1	M2	M3	M4
NEMATODA					
1. Nematoda sp.	+	+	+	+	+
NEMATOMORPHA					
2. Gordius aquaticus	+	+			
OLIGOCHAETA					
3. Dero sp.	+		+	+	
4. Dero dorsalis Ferroniere, 1899.	+				+
5. Nais communis	+	+	+		+
6. Nais elinguis	+				
7. Nais bretscheri Michaelsen, 1899	+			+	+
8. Ilyodrilus hommoniensis Oeschmann, 1913	+			+	+
9. Tubifex tubifex (O.F. Muller)	+	+	+	+	
CRUSTACEA					
10. Ostracoda sp.	+	+			+
11. Cyclopoida sp.	+	+			
12. Gammarus pulex	+	+	+	+	+
ARANEIDA					
13. Hydrachneida sp.	+	+			+
14. Araneina sp.	+	+	+	+	+
COLLEMBOLA					
15. Podura aquatica	+	+	+	+	+
EPHEMEROPTERA					
16. Baetis rhodani Pictet1843	+	+	+	+	+
17. B. buceratus Taton, 1870	+	+		+	
18. B.(Baetis) gemelus Eaton, 1870	+	+			+
19. B.(B.) ilex Jakob et Zimm.,1978	+			+	+
20. B.(Nigrobaetis) muticus (L., 1758)	+				+
21. B (N.) digitatus Bengtsson, 1912	+	+	+		
22. B.(N.) niger (L., 1761)	+	+		+	+
23. Baetis baksan Soldas, 1977	+		+		
24. Baetis sp.	+	+	+	+	+
25. Epeorus caucasicus (Tsh., 1938)	+	+	+	+	+
26. Ecdyonurus (E.) venosus (Fabr., 1775)	+			+	
27. Rhithrogena caucasica Braasch, 1979	+	+			+
28. Heptagenia sulfurea Muller	+				+
29. Heptagenia flava Rostock, 1878	+	+	+	+	+

Species	Sum	Monitoring stations			
		M1	M2	M3	M4
PLECOPTERA					
30. Bracbvptera transcaucasica Zhiltz., 1956	+			+	+
31. Perla caucasica Guer.	+	+			
32. P. pallida Guer, 1838	+				
33. Perlodides microcephala (Pict, 1833)	+	+	+	+	+
34. Isoperla caucasica Balin, 1950	+			+	+
35. Capnia nigra Pict, 1833	+	+	+		+
36. Taeniopteryx caucasica Zhiltz.	+	+	+	+	+
37. Amphinemura trialetica Zhiltz, 1957	+			+	
38. A. mirabihs (Mart, 1928)	+				
39. Protonemura ailticola	+	+		+	
40. P. bacurianica Zhiltz, 1957	+		+		+
41. P. capitata Mart, 1928	+				
42. Nemoura cincrea (Retz., 1783)	+		+	+	
43. Leuctra fusca L., 1758	+			+	+
44. L. hippopus Kemp, 1899	+			+	+
LEPIDOPTERA					
45. Pyralididae sp.	+	+		+	
COLEOPTERA					
46. Lacophilus sp.	+	+			
47. Agabus areticus	+				+
48. Hydrochus elongatus	+			+	
HETEROPTERA					
49. Micronecta pusilla (Horvath, 1895)	+	+	+	+	+
50. Corixa punctata (Illiger, 1807)	+	+			+
TRICHOPTERA					
51. Glossosoma capitatum Mart, 1913	+		+	+	
52. G. unguiculatum Mart, 1925	+	+	+	+	
53. Drusus caucasicus	+	+	+	+	
54. Sericostoma grusiensis	+	+			+
55. Rhyacophila nubila Zett, 1840	+			+	
56. Rh. forcipulata Mart., 1926	+				+
57. Potamophylax latipennis Curt, 1834	+			+	
58. Diplecrona felex	+	+			
59. H. Instabilis Curt., 1834	+	+	+	+	
CHIRONOMIDAE					
60. Coryneura skutellata	+	+	+	+	
61. C. lobata	+			+	+
62. Diamesa insignipes Kieffer	+	+	+	+	+
63. Diamesa longipes	+	+	+	+	+
64. Diamesa baiadensis	+	+			+
65. Syndiamesa branickii	+				+
66. Pseudodiamesa branickii	+			+	

Species	Sum	Monitoring stations			
		M1	M2	M3	M4
67. Parorthocladius nudipennis	+			+	
68. Parametriocnemus boreoalpinus	+			+	
69. Eukiefferiella alpestris	+	+	+	+	+
70. E. devonica	+	+		+	
71. E. longicalcar	+			+	
72. E. lobifera	+	+			+
73. Endochironomus stackelbergi	+				
74. Heleniella ornaticollis	+			+	
75. Orthocladius rivicola Kieffer	+			+	+
76. O. rivulorum	+		+		
77. O. bicinctus	+	+			+
78. O. obumbratus	+	+		+	+
79. Synorthocladius semivirens	+			+	
80. Crycotopus algarum	+	+		+	+
81. C. trianulatus	+				+
82. Chironomus sp.	+	+			+
83. Tanytarsus verralli	+	+		+	
DIPTERA					
84. Diptera sp.	+	+			
85. Atherix ibis (F.)	+	+	+	+	+
86. Dixa sp.	+			+	+
87. Brachycerus sp.	+				+
88. Erioptera lutea	+			+	
89. Wiedemannia zettertealti	+			+	
90. Prinocera turcica	+			+	
91. Pericoma falax	+			+	
92. Orimarga attenuata	+			+	
93. Scleroprocta sp. Limmonidae	+				+
94. Simulium caucasicum	+	+		+	+
95. S. ornatum	+	+		+	
Total	95	49	29	60	53