

The study of reproduction ecology of endangered  
endemic fish species Sevan Trout

Initial report for the period of 01.03.15-20.06.15

As it is known, Sevan trout is one of the most valuable fish species of Armenian ichthyofauna. However, it is endangered nowadays, as a result of mismanagement of Lake Sevan water and bio-resources and anthropogenic impact on the rivers inflowing into the lake. Because of lake's water level decrease in 1930-1990's, many clues in the shore zone of Lake Sevan became dry and some races of Sevan trout, which spawn in the lake, lost their spawning areas. Thus, these races have been eliminated. Summer trout and Gegharquni trout, which spawn in the Lake Sevan basin rivers, have survived, but have become rare. Significant changes in their ecology and reproduction have also taken place, that's why the aim of the project is to reveal the current state of Sevan trout reproduction ecology and the problems constraining its natural reproduction in Bakhtak, Tsakqar and Lichq rivers.

During the reporting period, two field trips to the rivers of Lake Sevan basin were organized in May and two more field trips - in June. In May only the downstreams of the rivers were studied, because in this period of time, as a result of temperature regime, the mature individuals of Sevan trout carrying out spawning migration can reach only these parts of the rivers (fig. 1).

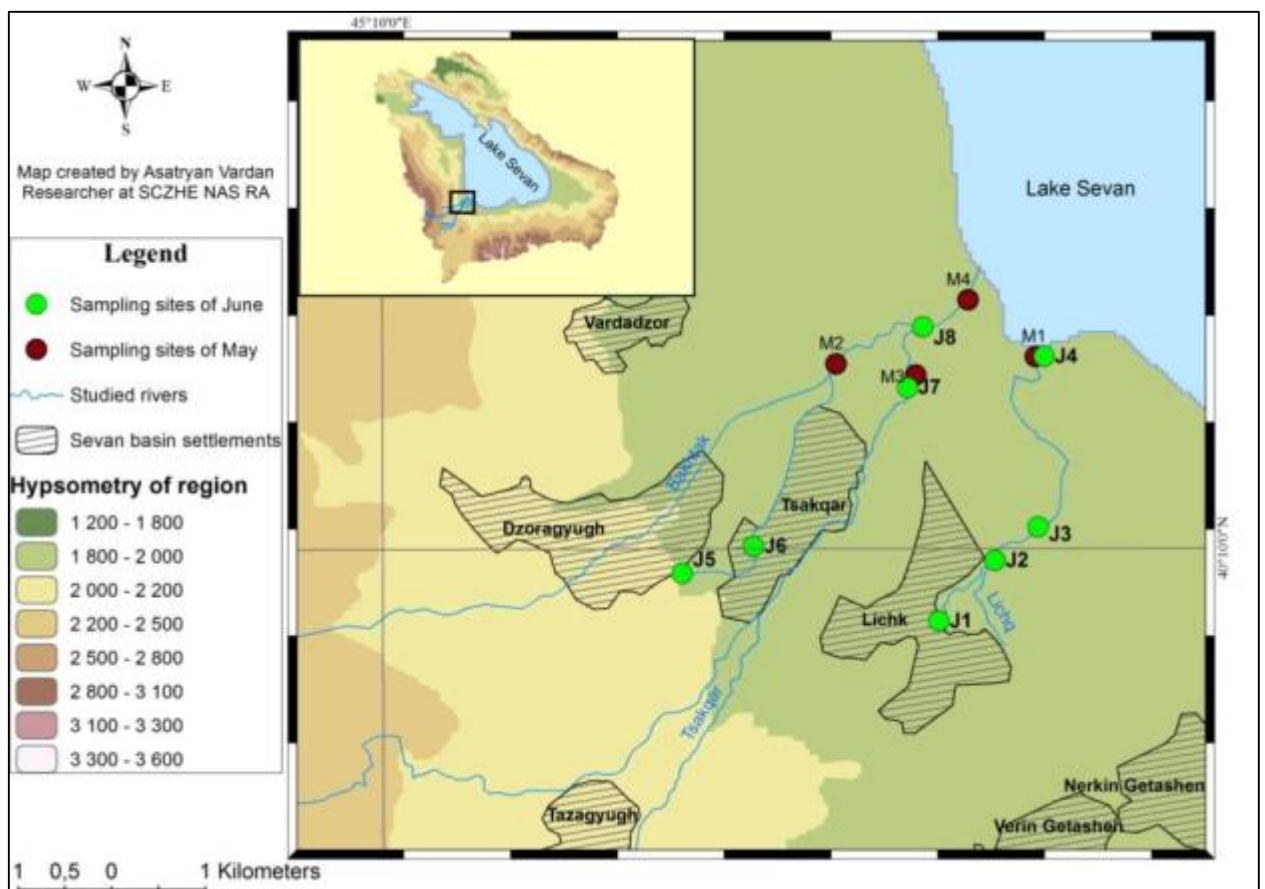


Fig. 1 Studied areas

In June, the middle streams and some upper streams were also studied to reveal as well the appropriateness of these parts as spawning areas. Despite the fact that Bakhtak and Tsakqar rivers are mentioned as separate rivers in the literature, our studies show that they are joining and inflowing into Lake Sevan as one river.

Our measurements also show, that water discharge of Bakhtak river in intersection (sampling site J8, Figure 1) is higher than water discharge of Tsakqar river, which means that Tsakqar river is a tributary of Bakhtak river. At the same time, there are obvious differences in the water quality of these rivers. Thus, we'll try to reveal these differences more precisely in the next field trips to understand whether they are significant enough to influence the preferences of trout during spawning migration.

According to the project plan, the following activities during May-June field trips were carried out:

1. Study of some hydro-physical and hydro-chemical parameters of the chosen rivers to reveal the conditions of possible spawning areas and their possibilities to support the natural reproduction of Sevan trout races, as well as to find the possible obstacles for trout migration to the upper streams of the rivers
2. Study of benthic macroinvertebrates community in the parts of the rivers suitable for spawning to reveal the feeding base of fries, which will grow in the rivers before migration to the lake and future assessment of water quality in these areas
3. Study of Sevan trout races in natural conditions to reveal some morph-metric parameters of caught fish, as well as the stage of sexual maturity of individuals
4. Mapping of studied areas to improve the spatial recognition of the problem and help authorities in decision making.

Results and discussion. The first investigated difference within two months was the hydrological characteristics of the rivers. In May, all rivers were more saturated as a result of snow melting in the upper streams and rainy weather. This fact influences not only the hydro-chemical parameters but also the hydro-biological sampling. Probably it influenced the sampling of benthic macro-invertebrates in the downstream of Lichq river in May, because the diversity of zoobenthos in this station was too low, which was unusual for this river. It could also be the cause of lack of the caught fish in this season.

The spawning of Sevan trout is highly dependent on water temperature in the rivers. It's known that the optimal average temperatures of water for Gegharquni and Summer trout start from +5.5<sup>0</sup>C and +7.8<sup>0</sup>C respectively. But usually only downstreams of these rivers satisfy this parameter in May, that's why the field trips have been carried out mainly in these areas of rivers.

The study of temperature parameter in the downstreams has shown that in the morning time (the lowest possible temperature within one day) average temperature was the lowest in Bakhtak river + 5.5<sup>0</sup>C, whereas in the two other studied rivers the average temperatures in the morning were quite higher: +7<sup>0</sup>C in Lichq river and +8.5<sup>0</sup>C in Tsakqar river. Moreover, the temperature of Lichq river water fluctuated with a smaller rate, because of nourishment features (90% of nourishment is from wellsprings). Provided data proves that the water temperature is appropriate for the spawning migration in all studied areas. The literature data for these rivers also shows that annual water temperatures for the May are optimal for spawning. For example the average temperature of Lichk river water for May is +9.6<sup>0</sup>C, for Bakhtak river water - +9.5<sup>0</sup>C and for Tsakqar river water - +10<sup>0</sup>C.

During June expeditions, water level decrease took place and some temperature fluctuations were also registered. Water temperature in the middle and upper streams of studied rivers fluctuated from +7.6<sup>0</sup>C in Lichq river sources to +9.4<sup>0</sup>C in Bakhtak river (sampling site J6), but water temperature in downstreams was much higher: from +14.6<sup>0</sup>C in Lichq estuary to +13.5<sup>0</sup>C in Tsakqar river (sampling site J7) (Table 1).



Fig.2 Hydro-chemical and hydro-physical measurements in J1 station

The measured average value of pH parameter for May season varied from 7.8 in Lichq river (sampling site M1) to 8.07 in Tsakqar river (sampling site M3). Moreover, all the measured values of pH (Table 1) have been common for the Lake Sevan basin rivers and appropriate for the trout. Extended studies in June season revealed more differences in this parameter. For example, it's been revealed that in the Lichq river springs water was near acidic (pH value in sampling site J1 is 6.92) and, opposite to this, the pH value in sampling site J7 (Tsakqar river) was 9.01, which probably was the result of influence of wastewater. Logically, the high value of pH in the intersection of Bakhtak and Tsakqar rivers (sampling site J8) was also the result of water transported by Tsakqar river.

Table 1. Some hydro-physical and hydro-chemical parameters of studied rivers

Sampling site Name	Average Dissolved Oxygen (mg/l)	Average Oxygen saturation (%)	Average temperature (°C)	Average value of pH	Dominant ground types
M1	8.8	78	+8.7	7.8	sand, mud
M2	8.5	80	+9.1	7.87	sand, mud
M3	9	96	+8.1	8.07	cobble, gravel
M4	8	72	+10.5	8.01	sand, mud
J1	10,8	89	+7.6	6.92	gravel, cobble
J2	11.72	100.5	+8.6	7.07	cobble, gravel
J3	11	99	+10.7	7.26	cobble, sand
J4	10.5	85	+14.6	7.52	sand, mud
J5	10.2	92	+7.9	7.15	artificial
J6	11.85	103	+9.4	7.58	gravel, cobble
J7	8.15	90	+13.5	9.01	gravel, cobble
J8	9.8	95	+13	8.56	cobble, gravel

The other two measured parameters - Dissolved oxygen (DO) and saturation of water by oxygen didn't reveal serious problems along rivers and we could primarily conclude that these parameters couldn't be constraining factors for the migration of Sevan trout to the spawning areas. In May season, when water level was increased and turbidity of water was higher, these parameters were lower than in June. The measured value of DO in June fluctuated from 8.15 in Tsakqar river (sampling site J7) to 11.85 in Bakhtak river (sampling site J6), and saturation with oxygen - from 85% in Lichq estuary to 103% in Bakhtak river (sampling site J6). In opposite to this, the highest value of DO in May was registered in Tsakqar river (sampling site M3). And it's interesting that the changes in absolute values of DO in May and June have been small in this area. Such high values of DO and water saturation by oxygen is a result of high turbulence and small depths. That's why this parameter decreases in the down streams. But in some cases it can

also be high due to high biomass of submerged macrophytes, which in their turn show the presence of organic matter in the water.

One more important factor for the trout spawning is ground type. It's known that Sevan trout prefers to spawn in the cobble and gravel and here is the biggest contradiction in studied rivers. As it shown in the table 1, appropriate ground type for the spawning is in the middle and upper streams of the rivers, where rivers flow in the settlements and other human activity areas, which creates artificial difficulties for trout migration and spawning. For example the abandoned dam (figure 2) in the middle stream of Lichq river creates a good condition for the accumulation of trout fries under it, and poachers are using this fact to catch them before they rich maturity and, as a result, additionally influence the trout population shrinking. The same situation is in Bakhtak and Tsakqar rivers. In contrary, ground type of downstreams mainly consists of sand and mud, which is accumulated in those parts due to the decrease in water velocity and meandering of the rivers.



Fig. 2 Small dam in Lichq river (sampling site J3)

The next core part of our complex studies is the investigation of benthic macroinvertebrates as a diet base of fish and indicators of ecological condition of the water. For these purposes, qualitative and quantitative structures of benthic macroinvertebrates have been revealed and, based on determination of zoobenthos up to families, water quality has been revealed as well.

The highest diversity of macroinvertebrates has been recorded in the sampling site M4 (Bakhtak river estuary) (Table 2), where the highest biomass of macro-invertebrates (21170mg from 0.5m<sup>2</sup> sampling area) has been recorded as well. 57% of this biomass was the larvae of caddisfly (Trichoptera). We can conclude from all above mentioned that, in this period, the possibility of food electiveness for Sevan trout in the sampling site M4 was the highest.

The water quality of studied sampling sites has been assessed according to the BMWP (Biological Monitoring Working Party) index in order to reveal the ecological state of potential spawning areas of Sevan trout. The assessment has shown that the best water quality among all studied areas was also in the sampling site M4, where the value of BMWP index is 54, which means “Good” water quality.

Table 2. The quantitative and qualitative structure of benthic fauna in the studied areas

Taxonomic group	Bakhtak				Tsakqar		Lichq	
	Sampling site M4		Sampling site M2		Sampling site M3		Sampling site M1	
	Quantity in 0.5m <sup>2</sup> sample (ind.)	Biomass in 0.5m <sup>2</sup> sample (mg)	Quantity in 0.5m <sup>2</sup> sample (ind.)	Biomass in 0.5m <sup>2</sup> sample (mg)	Quantity in 0.5m <sup>2</sup> sample (ind.)	Biomass in 0.5m <sup>2</sup> sample (mg)	Quantity in 0.5m <sup>2</sup> sample (ind.)	Biomass in 0.5m <sup>2</sup> sample (mg)
Hirudinea	34	1047	49	473	3	68	0	0
Chironomidae	424	2750	108	108	35	110	200	140
Ceratopogonidae	24	24	16	6	7	4	0	0
Diptera	3	8	0	0	0	0	0	0
Simuliidae	84	410	21	120	0	0	1	1
Oligochaeta	4	2	0	0	8	2	7	1
Ephemeroptera	111	586	160	1133	244	909	0	0
Coleoptera	4	6	3	5	24	33	0	0
Tabanidae	0	0	1	3	1	68	0	0
Tipulidae	1	3	0	0	0	0	0	0
Gastropoda	5	233	1	3	55	200	2	364
Gammaridae	182	4100	1	3	0	0	3	11
Bivalvia	1	1	0	0	0	0	0	0
Trichoptera	51	12000	23	1000	5	166	0	0
Total		21170		2854		1560		517
Water quality	Good		Not high		Not high		Bad	

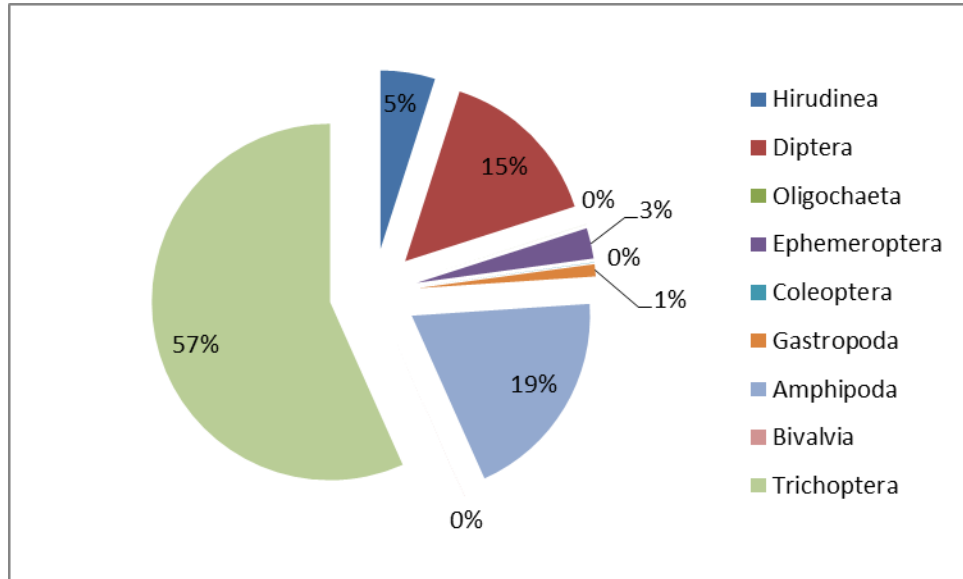


Fig. 3 The ratio of biomass of benthic macroinvertebrates in the sampling site M4

The quantitative and qualitative structure of benthic macroinvertebrates of other sampling sites (M1, M2, M3) has been significantly low. The total biomass of benthic macroinvertebrates of these stations has been decreased as well (Tab. 2).

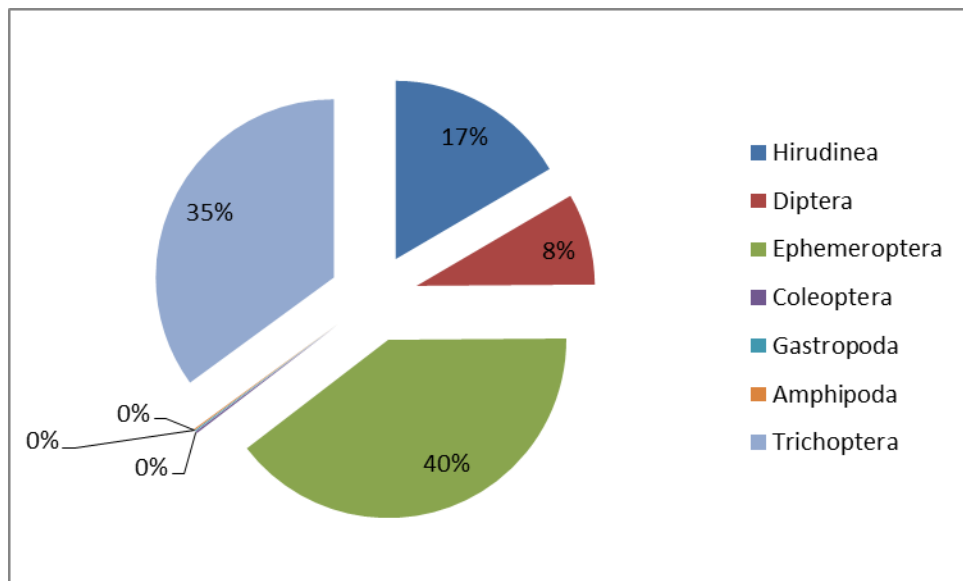


Fig. 4 The ratio of biomass of benthic macroinvertebrates in the sampling site M2

The larvae of mayflies (Ephemeroptera) have been dominant in the M2 and M3 stations (fig. 4 and 5). Water quality in M2 and M3 sampling sites has been assessed as “not high” according to BMWP index.



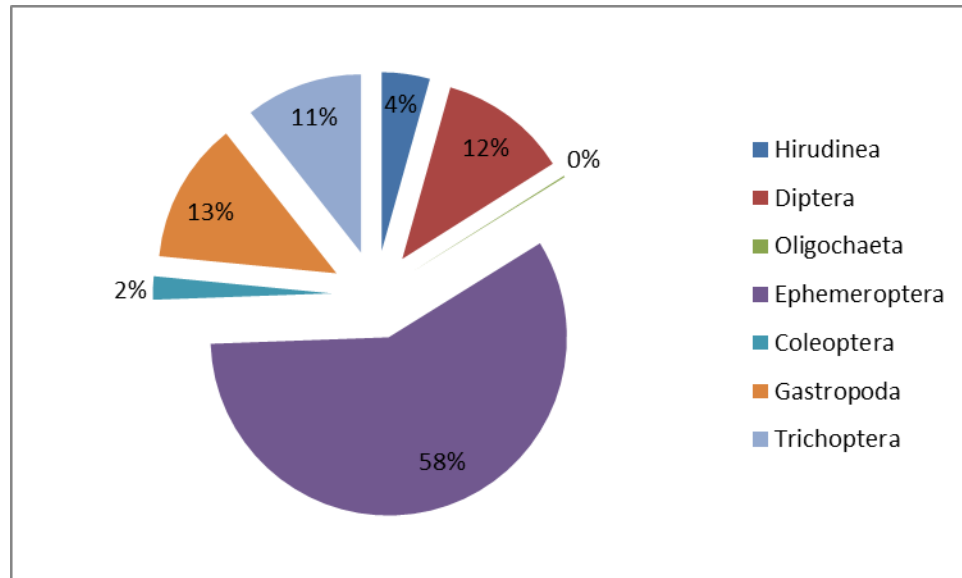


Fig. 5 The ratio of biomass of benthic macroinvertebrates in the sampling site M3

The worst water quality has been registered in sampling site M1 (Lichq river estuary), where BMWP value was 17, which means “Bad” water quality. The representatives of only 4 taxonomic groups have been registered in this station. 71% of total biomass of benthic macroinvertebrates in this station has been mussels (Gastropoda) (fig. 6). Probably this situation is the result of sampling procedure problems in this area due to oversaturation of river in May.

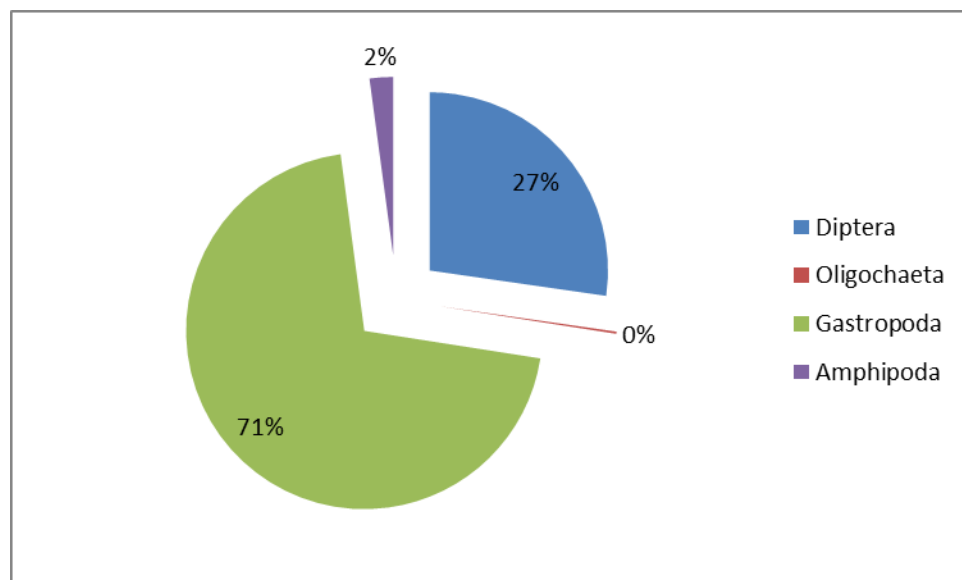


Fig. 6 The ratio of biomass of benthic macroinvertebrates in the sampling site M1

The processing of samples of benthic macroinvertebrates from June season is currently underway and the results will be published in the next report, but we can say that there are some changes in ecological states of the rivers when compared with May.

The ichthyological studies proved the critical situation with Sevan trout. During 12 days of intensive works a total of 9 individuals of Sevan trout were caught and none of them were sexually mature (Fig.7). Moreover only 3 individuals have been caught in May. Two of them have been caught from sampling site M3 (Tsakqar river), and 1 - from sampling site M2 (Bakhtak river).



Fig. 7 Sevan trout

Small amount of fish can probably be the result of high water level in the rivers. Six fish caught in June season have been approximately the same size as the ones caught in May. The average length of fish has been 15cm, the maximal length - 17cm, minimal length - 14cm. The average mass has been 50g, minimal mass - 35g, maximal - 60g.

All individuals have been in good health conditions, without external parasites and visual physical defects. Thus, they have a possibility to become sexually mature and to reproduce. Based on size-age investigations of trout we can say that the first spawning of these fish can be only after 2-3 years. 1 individual from 9 has been summer trout, whereas the other 8 have been Gegharquni trout.

Caught fish hasn't been tagged by hydrostatic tags, because only sexually mature individuals can be tagged during this program.



Fig. 8 Releasing the caught fish in Lichq river

There are many artificial constraining factors for trout migration in the territories of villages. For example, during the field trips we have found a significant amount of garbage in all three rivers, which is the result of weak waste management in the villages (fig. 9).



Fig.9 Garbage in Bakhtak river middle stream

One more problem is the closeness of the houses to the rivers in the villages. Furthermore, in some cases river flows by the territories of private gardens and houses, and there is no guarantee that dwellers are not using non-permitted fishing devices and other methods to catch fish or, for example, to use the river water in their territories. This problem also needs strict regulation and monitoring, as well as activities aimed at raising the ecological consciousness of native dwellers.