



Assessment of impact of construction and operation of small Hydroelectro power plants on fish and ecological state of rivers of Ukrainian Carpathians

**Afanasiev S.A., Dolinskiy V.L.,
Letitska O.N. Bilous O.P.**

At mountain rivers in Zakarpattia,
Ivano-Frankivsk, Lviv and Chernivtsi
oblasts (Carpathian region)

it is planned to build about **570** small
hydropower plants.



Main problems of small hydropower plants (HPP)

- Direct destruction of habitats and landscapes and, as a consequence, the disappearance of aquatic organisms, including the Danube salmon and many species of the Red Data Book of Ukraine.
- Changes in the hydrological regime due to damming (HPP with reservoir) and redistribution of river runoff (Derivative HPP).
- Interruption of migration ways of anadromous and catadromous fish and invertebrates.
- Pollution of rivers by combustive and lubricating materials.
- Issue of the environmental safety of the surrounding settlements, including cities, for which the mountain streams are the source of water.



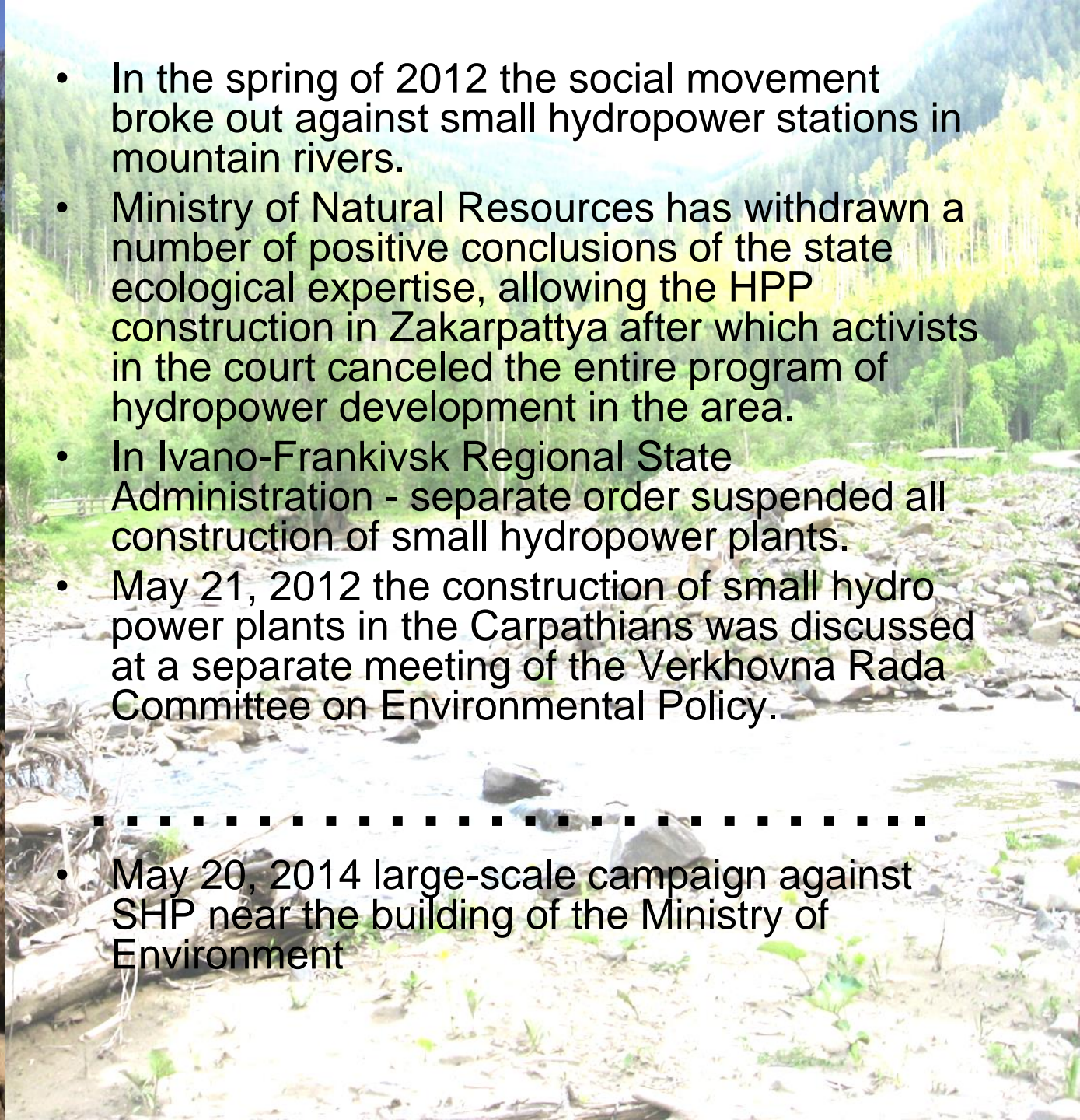
- **local people will be deprived of the opportunity to improve their standards of living through environment, sports and green tourism.**



- In the spring of 2012 the social movement broke out against small hydropower stations in mountain rivers.
- Ministry of Natural Resources has withdrawn a number of positive conclusions of the state ecological expertise, allowing the HPP construction in Zakarpattia after which activists in the court canceled the entire program of hydropower development in the area.
- In Ivano-Frankivsk Regional State Administration - separate order suspended all construction of small hydropower plants.
- May 21, 2012 the construction of small hydro power plants in the Carpathians was discussed at a separate meeting of the Verkhovna Rada Committee on Environmental Policy.

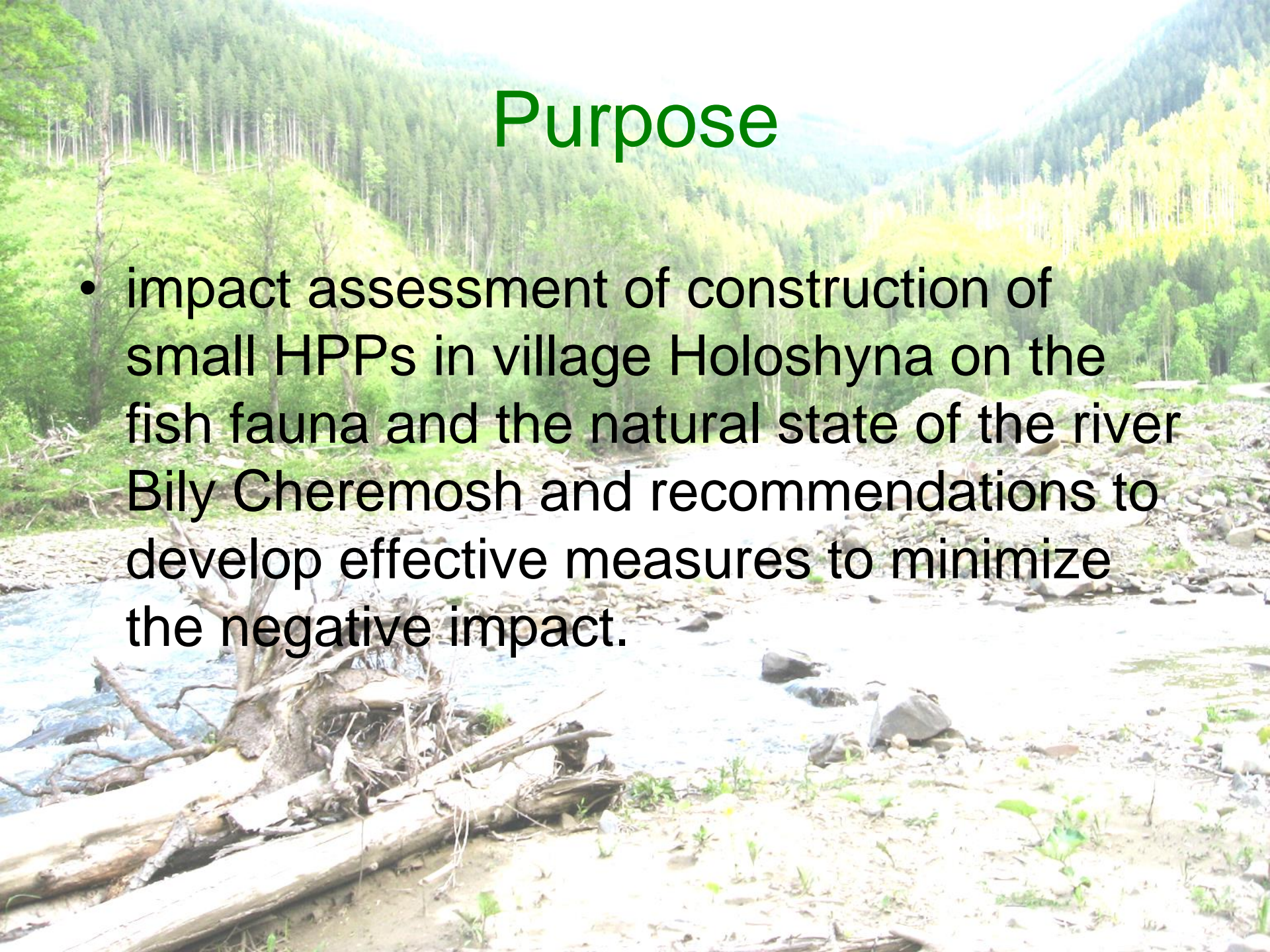
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- May 20, 2014 large-scale campaign against SHP near the building of the Ministry of Environment



Purpose

- impact assessment of construction of small HPPs in village Holoshyna on the fish fauna and the natural state of the river Bily Cheremosh and recommendations to develop effective measures to minimize the negative impact.

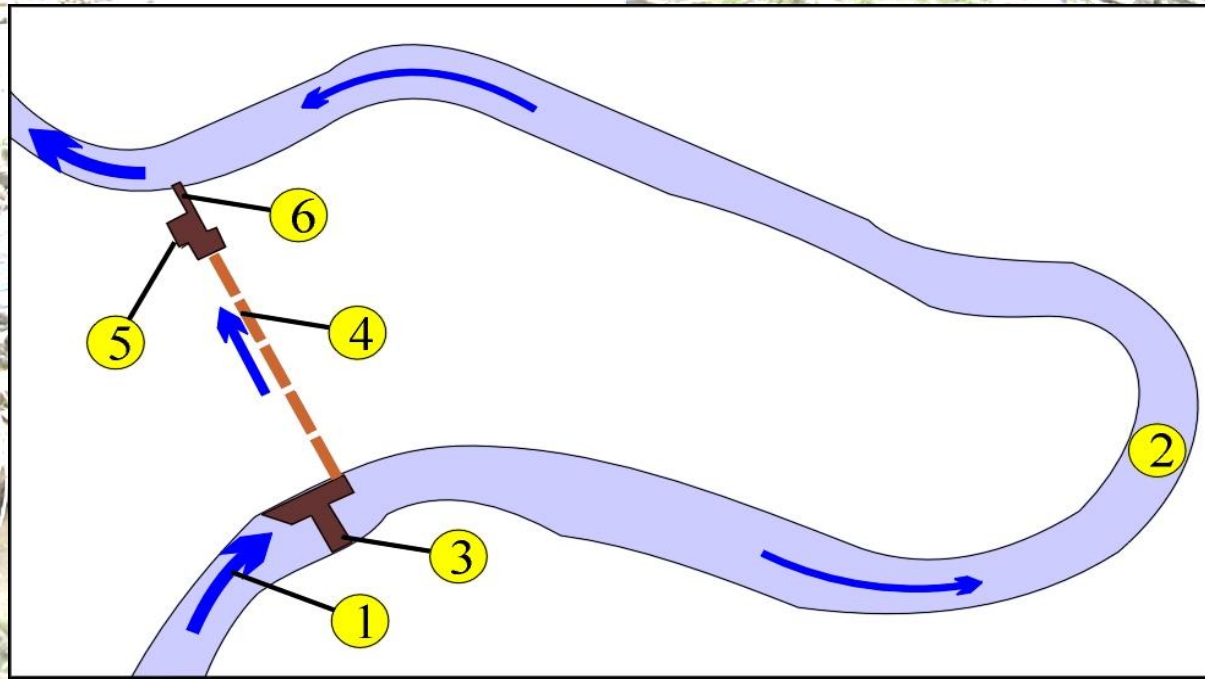


Map of Holoshyn derivative HPP-2

HPP 1 – Provides for the creation of the channel reservoir,

HPP 2 - is a derivational station of mixed type in which the pressure is created by the dam and discharge tunnel with a total pressure of 18 m and consists of the following elements:

- river Bily Cheremosh - 1, 2 (exists)
- receiving water from the dam (project) — 3
- pressure tunnel (project) - 4
- building plant (project) - 5
- construction of water outlets - 6



Methodology

- This study is based on the **international system of environmental assessment ESIA-quality** assessment on the basis of Ukrainian legislation and of modern hydro-ecology developments. It used the archives of the Institute of Hydrobiology, National Academy of Sciences and publications of Ukrainian and foreign scholars and modern information received: from the Work Projects Transcarpathian geodetic-cadastral center "Earth" service "Google", hydrometeorological service.
- In addition to documentary material this report used data from field hydrobiological and ichthyological investigations of Bily Cheremos river conducted by the Institute of Hydrobiology of NAS of Ukraine in May and August 2012.

Protected species

- According to studies conducted in 2012, in the waters of Bily Cheremosh River the following species classified as **Carpathian Red List** were found : *Trocheta bykowskii* Gedroyc, 1913 *Calopteryx splendens* (Harris, 1782) *Cordulegaster bidentata* Selys , *Cordulegaster bidentata* Selys, 1843, *Isogenus nubecula* Newman, 1833, *Perla burmeisteriana* Claasen, 1936, *Pepla marginata*, *Xanthoperla apicalis*, *Isoperla grammatica* (Poda, 1761), *Isoperla obscura* (Zetterstedt, 1840), *Brachyptera braueri* (Klapalek, 1900) [38].
- Ichthyological research in the Bily Cheremosh river found 3 species listed in the **Red Book of Ukraine**: :
 - Carpathian lamprey *Eudontomyzon danfordi* (Regan, 1911);
 - Common barbel *Barbus barbus* (Linnaeus, 1758);
 - Danube salmon *Hucho hucho* (Linnaeus, 1758).
- Possible, but not yet found in Bily Cheremosh - burbot *Lota lota* Linnaeus, 1758).

Effects on aquatic invertebrate animals

- Operation of hydropower plants reservoir in the absence of measures to minimize the negative impact may have such negative factors for benthic fauna :
 - 1. Changing the flow speed;
 - 2. Changing the flow of sediment;
 - 3. Changing the particles distribution in the soil;
 - 4. Siltation;
 - 5. Mechanical damage to organisms during the passage of the turbine;
 - 6. Mechanical and hydraulic obstacles to migration.

The negative impact of these factors will affect 118 of 139 species of benthic fauna,

Effects of negative factors in the reservoir will be: changing habitats of flora and fauna species, gaps in spatial and temporal terms, ruining of interexchange of substances, increased mortality of invertebrates passing turbine, substitution of reophilic species by limnophilic ones, destruction of environmental chain.

Sedimentation and slight increase of the temperature support increase of biological productivity.

Effects on fish

- **Increase in water temperature.** Slowing of flow speed in the reservoir and slight increase in the water temperature are favorable for feeding young Danube salmon, gradually moving (downstream migration) from spawning grounds in the upper reaches of the river.
- **Migration barriers.** Creating a dam with backwater 6.5 m interrupts upstream migration of Danube salmon, madder and other migratory species to spawning grounds located upstream the dam. In the absence of measures to minimize the impact. It causes fragmentation of the river at the site, as a result Danube salmon completely loses its ability to penetrate the top areas for spawning.
- **Fluctuations of water levels.** HHP can have a negative impact on the development of caviar due to unstable water levels in the upper parts and downstream that in the absence of appropriate measures to maintain proper water level can cause drying of caviar.
- **Injury by turbine.** The operation of HPP is associated with hydroelectric pass through large amounts of water, which may have a number of youth and adult fish. Getting into the turbine fish can be injured and die. European and American researchers found that the extent of injury and death depend on the pressure at the station, type of turbines and some of its characteristics. It is known that the adjustable-blade turbines Kaplan type are less traumatic than other turbine types. The turbine "Cink" selected for Bily Cheremosh belongs to the type of Kaplan. However, the speed of rotation, in terms of safe passage of fish is too high: at minimum speed (306 r / min) the linear velocity at the ends of blades is 1200 m / min or 72 km / h and at maximum speed (856 r / min) linear speed is 3386 m / min, or 204 km / h. This is an extremely "unfriendly" speed for fish, which in the absence of measures to minimize the negative impact leads to their death.

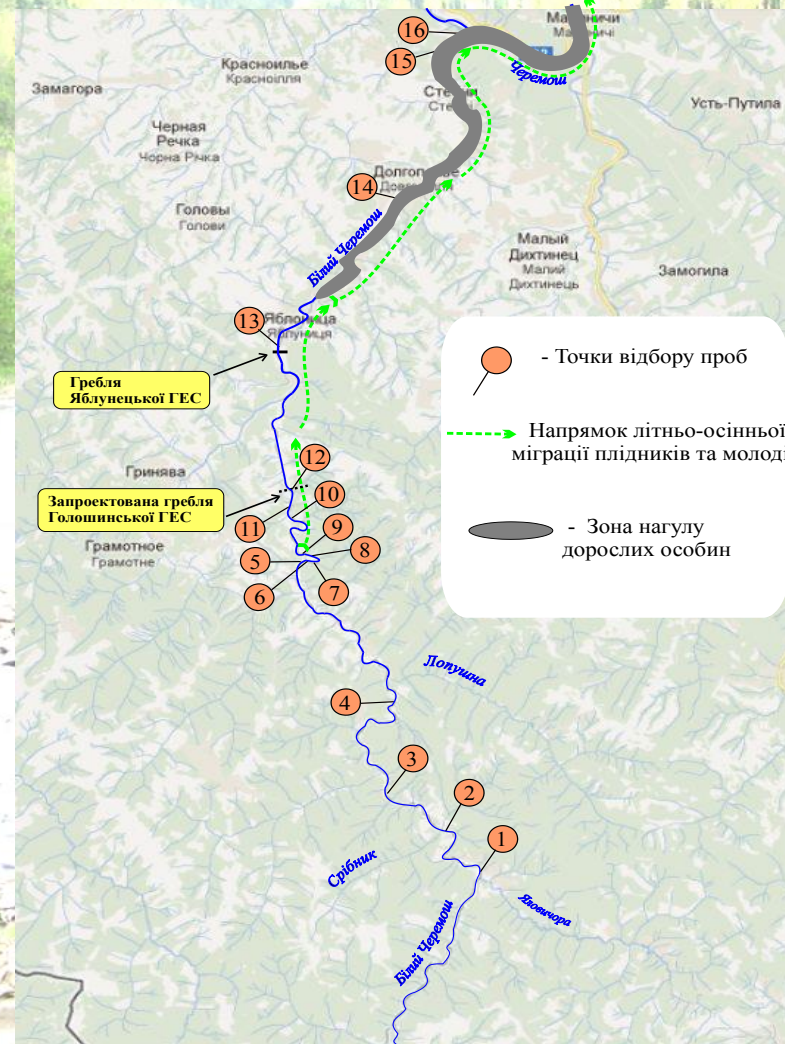
Examples of badly built fish passes



Danube salmon migration after spawning in the river Bily Cheremosh (Google maps hydrography)



Common barbel migration after spawning in the river Bily Cheremosh (Google maps hydrography)



CONCLUSIONS

- 1. River Bily Cheremosh is an important part of the ecosystem of the Carpathians, which is of great importance to preserve reproductive diversity of fish fauna of the mountain.
- 2. According to typology adopted by EU Water Framework Directive, Bily Cheremosh is **heavily modified water body**, due to the presence in it Yablunetska HPS.
- 3. Modern research has confirmed the presense in Bily Cheremosh upstream Yablunetsky dam populations of the Carpathian lamprey (*Eudontomyzon danfordi*), Common barbel (*Barbus barbus*), Danube salmon (*Hucho hucho*) - species listed in Red Book of Ukraine.
- 4. Construction of Holoshynska HPP dam and hydroelectric reservoir filling will temporarily affect the hydrological and hydrobiological regimes of Bily Cheremosh River if mitigation measures will be taken.
- 5. Operation of Holoshynska HPP is possible under the following conditions:
 - availability of working fish pass;
 - availability of working fish protection device;
- 6. The proposed design of fish pass at Holoshynska HPP requires further development to allow migration of Common barbel
- 7. Construction of derivative HPP-2 will have temporary affect on the hydrological and hydrobiological regimes of Bily Cheremosh if relevant mitigation measures are taken
- 8. Operation of Holoshynska HPP-2 is possible under the following conditions:
 - presence of controlling device to pass sanitary and ichthyological releases;
 - Release of water to the area of natural bed of Bily Cheremosh from receiving waters point to water outlets must be at **least minimum sanitary**:
 - For winter - at least **0.357 m³ / s**;
 - For the period of open water - at least **0.784 m³ / s**;
 - For spawning period, to ensure depth of at least 24 cm - approximately **1.28 m³ / s**.
 - Availability of working fish pass;
 - existence of fish protection device on intakes.

RECOMMENDATIONS:

- During construction of fish pass, the length of a camera should be **2.5 m**, flow velocity in the inlet of fish pass should **0.7 m/s**.
- While constructing the fish pass, there should be a rotation of **inclined** (length 7.8 m) and **horizontal** (length 3 m) plots.
- To conduct environmental monitoring during construction and operation of hydropower plants.