



# LJUBLJANICA CONNECTS

LIFE10 NAT/SI/142

## AFTER-LIFE CONSERVATION PLAN



Ljubljana, October 2016

## ABOUT THE LIFE PROGRAMME

The LIFE programme is the EU's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value.



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## ABBREVIATIONS

EC – European Commission

MOP – Ministry of Environment and Spatial Planning

UL FGG – University of Ljubljana, Faculty of Civil and Geodetic Engineering



# 1 ABOUT THE LJUBLJANICA CONNECTS PROJECT

The main project objective was the improvement of the ecological function, connectivity, and passability of the Ljubljana River reach from the City of Ljubljana downstream. The Ljubljana river is an important habitat for target Natura 2000 fish species: Danube salmon (*Hucho hucho*), Danube roach (*Rutilus rutilus*), and striped chub (*Leuciscus souffia*). According to the Rules on the Inclusion of Endangered Plant and Animal Species in the Red List (Official Gazette of the RS, Nos. 82/02 and 42/10), these species are included in the Red List of fish and cyclostomes as endangered species, whose survival in the area of the Republic of Slovenia is not probable if the risk factors remain in place. One of the main reasons why target fish species became endangered in the Ljubljana river was their inability to migrate through the non-functional fish passes around the hydraulic structures on the Ljubljana River, which for various reasons (e.g. flood safety, prevention of subsidence in the Ljubljansko barje area) interrupt the river's natural flow.

Other project objectives were improving the ecological status of the river with relatively simple restoration measures, implementation of ecohydrological studies, setting-up of a hydrological model to improve our knowledge about the Ljubljana, and awareness-raising among the general public, which, due to the past water management, still regards Ljubljana as a threat rather than an essential element of environmental quality. The project relates to the area along the entire Ljubljana river channel, from Vrhnika to its mouth to the Sava River. There are two Natura 2000 sites in the area: Ljubljansko barje (Ljubljana Marshes) and Sava–Medvode–Kresnice. In this project we focused on the most degraded section of the river, which flows through the city core of Ljubljana. Here we restored the fish passes at the gates at Ambrožev trg and at the dam at Fužinski grad as well as the gate lifting system at Ambrožev trg. We also improved the living conditions in the oxbow downstream from the centre of Ljubljana, at Zalog. Along the entire Ljubljana channel we carried out ichthyological surveys and installed measuring stations to record water level height, temperature, and concentration of dissolved oxygen in water.

**Project title:**

Restoration of the Ljubljana River Corridor and Improvement of the River's Flow Regime

**Acronym:**

Ljubljana Connects

**Duration:**

01/01/2012–31/08/2016

**Coordinating beneficiary:**

University of Ljubljana, Faculty of Civil and geodetic Engineering

**Associated beneficiaries:**

Geateh d.o.o. and Purgator d.o.o.

**Project manager:**

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**Project budget:** European Commission: 584,382.00 EUR (50%)  
Ministry of the Environment and Spatial Planning: 237,603.00 EUR (20%)



Project beneficiaries: 350,630.00 EUR (30%)

**Project website:**

[http://ksh.fgg.uni-lj.si/ljubljanaconnects/ANG/06\\_ljubljana/default.htm](http://ksh.fgg.uni-lj.si/ljubljanaconnects/ANG/06_ljubljana/default.htm)



## 1.1 SWOT ANALYSIS

We have used a structured planning method called SWOT analysis to evaluate the strengths, weaknesses, opportunities and threats at the end of the project. The analysis allows the identification of internal and external factors that are favourable or unfavourable to achieve a certain objective or a goal.

### STRENGTHS:

- An innovative way of monitoring the passage of fish through fish passes using two low-cost cameras was developed and used.
  - It allows for continuous monitoring of passage of fish through the fish passes.
  - This is a non-invasive method that does not interfere with the movement of fish and does not cause losses in the fish population.
  - The passage of fish through a barrier is continuously monitored and recorded, so no additional monitoring, forecasting, and timing of fish passage through the structures is necessary, unlike in some methods that involve fish catching.
  - All the images of the fish recorded by the camera are stored and allow for retrospective data analysis.
  - A live video stream on YouTube provides a view in the fish pass and its passability to the interested public.
- Improved communication and collaboration with other stakeholders (e.g. fishermen and operators of facilities).
- Better understanding of the passage of target fish species and other species across the fish passes.
- Presentation and dissemination of results both at national and international levels (e.g. at scientific and professional conferences).
- The new knowledge acquired in relation to the reconstruction of fish passes, which requires different procedures and materials than when building new structures.
- Easy access to regularly updated information on the project website.
- The setting-up of ecohydrological monitoring on the Ljubljanica River and its tributaries allows for regular monitoring of hydrological parameters and water temperature.
- Transmission of data from three online hydrometric stations to the website and a variety of possible applications.
  - The use of data from online monitoring points for a potential automated operation of the gates in the future.
- Improvement of living conditions in the oxbow at Zalog.
- Decreasing the sudden changes in the water level and water quality paired with the operation of the sluice gate at Ambrožev trg.
- Involvement of the young people (primary and secondary school pupils, higher education students) living along the Ljubljanica River in terms of awareness-raising about the significance of conservation and protection of target fish species and the natural environment.
- Integration of the knowledge acquired in the project into the study process

### WEAKNESSES:

- The method of monitoring the passage of fish through the fish pass still has some deficiencies:
  - currently unaffordable equipment for upgrading the monitoring system with two cameras,
  - regular maintenance of equipment is necessary,



- the monitoring system does not yet distinguish between fish and floating objects,
  - The recorded images have to be manually reviewed, sorted, and the recorded fish species identified.
- The ecohydrological monitoring must be regularly maintained, calibrated, and the data collected.
- Insufficient inclusion of key institutions into the project (Fisheries Research Institute of Slovenia, angling clubs, City of Ljubljana (MOL), Slovenian Environmental Agency (ARSO), responsible ministries).
- Limited access to objective information to some members of interest group when communicating through group leaders (e.g. the president of an angling club).
- Uncertain financing of implementing the preservation plan for target fish species.

#### OPPORTUNITIES:

- Reporting of results regarding the monitoring of migration of target and other fish species through the fish passes, where monitoring systems using two cameras are set up.
- Increasing the knowledge about fish migration through the structures on the Ljubljanica (when do they migrate, which are the most migratory species, etc.).
- Raising awareness and knowledge of local inhabitants and political decision-makers regarding the significance of conserving and protecting target fish species.
- Better communication among the various stakeholders (fishermen, hydrologists, civil engineers, biologists).
- Participation and attendance at various professional and scientific events and exchange of opinions and results.
- New information channels to inform people of the significance of maintenance of the structures for the passage of fish to upstream parts of rivers.
- The transfer of knowledge and experience from the project to other problematic locations in Slovenia and worldwide.
- Increasing the interest in fish preservation measures.
- Improving the system for continuous monitoring of the passage of fish across the fish pass:
  - so that the camera sensors will distinguish between fish and floating objects,
  - to allow for automated analysis.

#### THREATS:

- Lack of interest to take part in the development or use of the new way of monitoring the passability of fish passes with domestic professional community, which still insists on using traditional invasive methods.
- Too little interest of the media regarding the topics of conservation and the measures for improving the conditions of target fish species.
- Shortage of personnel and public events for presentation and awareness-raising about the issues related to the conservation of fish species after the completion of the project.
- Shortage of personnel for maintenance and upgrading of equipment for ecohydrological monitoring and monitoring of the passage of fish through fish passes.
- Lack of personnel for data analysis.
- Lack of staff for delivery of workshops with young people.
- Too little interest of the public regarding the topics related to restoration of fish passes





- and conservation of target fish species.
- Too little interest and concern of the professional community and responsible institutions regarding the significance and necessity of investments in the maintenance of structures such as sluice gates and fish passes.



## 2 THE AFTER-LIFE OBJECTIVES AND METHODOLOGY

The main objective of the After-LIFE Conservation Plan is further development and promotion of results of the project with a maximum added value (monitoring system of fish migration, ecohydrological monitoring system, programme of workshops for young people), which will in the long-term contribute to conservation or protection of target fish species in the LIFE Ljubljana Connects project: Danube salmon (*Hucho hucho*), Danube roach (*Rutilus pigus*), and striped chub (*Leuciscus souffia*). In the framework of the project, concrete measures were carried out, which allowed these and other species to migrate to the upstream parts of the river. The obstructed migration of fish was one of the main reasons why the target fish species were considered endangered according to the Rules on the Inclusion of Endangered Plant and Animal Species in the Red List (Official Gazette of the RS, Nos. 82/02 and 42/10) and inclusion in the Red List of fish and cyclostomes as endangered species, whose survival in the area of the Republic of Slovenia is not probable if the risk factors remain in place. The objective, therefore, is to maintain the appropriate conditions for the life of target fish species.

Specific goals, objectives, and proposed measures are presented in the chapters below. For each of the proposed measures, responsible organizations, sources of funding and costs were defined as well as the timeframe for the implementation. The After-LIFE Conservation Plan has been developed for the period of 5 years.

### 2.1 Monitoring of passage of fish through fish passes using cameras

#### Description:

During project implementation, UL FGG's staff developed a new, non-invasive monitoring system of fish migration, which allows for live streaming, via an internet connection, to YouTube, thus providing an insight for the interested public and, at the same time, continuous monitoring and storage of all the data on the fish migrating through the fish pass. The fish monitoring system consists of two parts: a water-resistant box with a tablet computer allowing for data capture and storage of images and a box containing a camera and supplementary illumination for night-time recordings.

#### Motivation:

There are already some other similar ways of monitoring fish migration, but they are more expensive and do not allow for major system modifications or upgrading. The developed system has proven to be efficient and was well received among professionals abroad. Its biggest advantages are affordability and the possibility of watching live-streaming videos.

#### Objectives:

- Continuing the monitoring of passage of fish through the fish passes using two cameras at Ambrožev trg and the Fužine weir.
- Monitoring, supervision, and cleaning of the equipment used for the monitoring of passage of fish through the fish passes.
- An improved monitoring system up to a point that the camera sensors will have the capacity to distinguish between fish and floating objects.
- Improvement of quality (resolution) of camera images for an easier and more accurate recognition of fish species.
- Promotion of the developed system, encouragement for installing such systems and thus a more efficient, continuous, non-invasive type of monitoring also in other fish passes in Slovenia and abroad.



**Measures:**

	Measure	Responsible	Necessary funds	Timeframe
1	Cleaning of cameras and maintenance of equipment for monitoring the passage of fish through fish passes.	UL FGG	Approx. 500 EUR/year	Continuous (as needed)
2	Maintenance of the server for the saving of images from the cameras at the fish passes.	UL FGG	Approx. 300 EUR/year	Continuous
3	Purchase of equipment to improve the monitoring system and resolution of camera images.	UL FGG, Geateh	Approx. 5000 EUR	When adequate and affordable equipment will be available.
4	Examination of recordings from the cameras in the fish passes and analysis of results.	UL FGG, Geateh, or external biologists	Approx. 3500/year	Continuous (monthly)
5	Development of the method and a software tool for automated processing of the images taken, and the exclusion of images without fish.	UL FGG	Salary for person who will develop the methodology and software. Approx. 2000 EUR/month	When adequate and affordable equipment will be available.
6	Promotion of the monitoring system and encouraging the installation of such systems in other fish passes in Slovenia and abroad – organisation of our own events and attendance at other events.	UL FGG	Approx. 5000 EUR/year	Continuous

**2.2 Ecohydrological monitoring and the use of recorded data****Description:**

In the framework of action A3, a network of 17 monitoring points was set up along the Ljubljanica River, where water level and water temperature are continuously recorded; furthermore, at three points sensors for monitoring dissolved oxygen in water were installed. We also installed three online recording stations. The data from these monitoring points are the basis for upgrading and calibrating the hydraulic model. Also, in the framework of the project an optic cable was bought to measure water temperature, which is different from standard, point measuring devices, as it allows for measuring and monitoring of temperature in long and short distances in various media (air, water, concrete, etc.).

**Motivation:**

High-quality data are essential for research and engineering planning. Continuous recording of discharge and other water characteristics with a such a high density of measuring equipment is relatively rare. Due to natural factors (elements), the failure of devices or loss in data over a longer time periods are frequent, which can be, however, quickly replaced with such good coverage as provided here. Continuous datasets provide an important



contribution to, and the basis of, any further study.

**Objectives:**

- Continuation of measurements at the 17 monitoring points set up on the Ljubljanica River and its tributaries and three online monitoring points.
- Maintenance, supervision, cleaning, and regular collection of data from the measuring equipment.
- Upgrading of the hydrological and hydraulic models according to the availability of software.
- Calibration of models using new data.
- Continuation of the use of the optical cable for temperature recordings (water, air, and other materials).
- The use of recorded data for teaching and study purposes, for professional work and research as part of undergraduate, Master's, and PhD theses.
- Use of measuring equipment for study purposes.

	<b>Measure</b>	<b>Responsible</b>	<b>Necessary funds</b>	<b>Timeframe</b>
1	Maintenance of monitoring points (sites), cleaning of measuring instruments, and data collection.	UL FGG	Approx. 1000 EUR/year	Continuous
2	Upgrading and calibration of the hydrological model using new measured data.	UL FGG	Approx. 800 EUR/year	As needed.
3	Upgrading and calibration of the hydraulic model using new measured data.	UL FGG	Approx. 800 EUR/year	As needed.
4	Use of measuring equipment and recorded data for professional work and research (undergraduate, Master's, and PhD theses).	UL FGG	Regular tasks.	Continuous
5	Recording the temperature of various media and materials using the optical cable.	UL FGG	Approx. 100 EUR/measurement	As needed.

**2.3 Dissemination, information, and networking**

**Description:**

During Ljubljana Connects project implementation, we increased the dissemination of results, exchange of experience, and awareness-raising regarding the conservation and protection of target fish species, restoration measures, etc. For primary and secondary school pupils we prepared a programme of workshops that were held as part of science days. We organised lectures on various topics and round-tables for students. The project and our work were also presented at international conferences, workshops, and round-tables.

**Motivation:**

The project deals with many interesting and current topics of interest to both professionals and the general public. Direct contact with people proved to be very productive. Participation



at conferences is a good way for networking and exchange of experience and knowledge, as it is done on a personal level. When interacting with young people, they were shown what happens in the world around them, thus encouraging their interest in the topics at hand.

### Objectives:

- Maintenance and regular updating of the project website with news and new results.
- Presentation and promotion of the acquired know-how, experience, and results in the project at domestic and international professional and scientific conferences.
- Organisation of various public events to raise awareness and inform the public on the project's results, significance of conservation of target fish species as well as maintenance and investment in structures intended for fish passage.
- Inclusion of experience gained in the project (e.g. procedures for reconstructing fish passes, which require a completely different approach than new constructions, procedures for sill reconstruction) into the learning content for students.
- Continuing with workshops for young people (primary and secondary school pupils, higher education students) to inform them about the need for conservation and protection of target fish species and their habitats.
- Distribution of the project's film Ljubljana Connects via YouTube and sending-out of DVDs.
- Maintenance of online transmission from the cameras in the fish passes to YouTube.

	Measure	Responsible	Necessary funds	Timeframe
1	Maintenance and regular updating of the project website.	UL FGG	Approx. 1000 EUR/year	Continuous.
2	Active participation at professional scientific conferences at home and abroad.	UL FGG, Geateh, Purgator	Approx. 500 EUR/event	As needed.
3	Organisation of various public events to raise awareness and inform the public about the project's results and significance of conserving target fish species, maintenance, and investment in reconstruction and building of structures for fish passage.	UL FGG, Geateh, Purgator	Approx. 200 EUR/event	As needed.
4	Presentation and treatment of the problems and solutions proposed in the project in the study process.	UL FGG	Part of regular tasks.	As needed.
5	Preparation of study materials on the topic of fish pass reconstruction and upgrading of the gate lifting system.	UL FGG	Approx. 1000 EUR	As needed.
6	Workshops for primary and secondary school pupils as well as higher education students	UL FGG	Approx. 200 EUR/workshop	Continuous.



7	Involvement in (natural and technical) science days and project days in primary and secondary schools in Ljubljana and elsewhere in Slovenia.	UL FGG	Transportation costs, approx. 500 EUR/year	Continuous.
8	Dissemination of results with a project film – sending-out DVDs and promotion of the film on the website.	UL FGG, Geateh, Purgator	Approx. 500 EUR	Continuous.
9	Maintenance of the online transmission of images from the cameras in the fish passes.	UL FGG	Costs included in server maintenance.	Continuous.

## 2.4 Control and supervision of reconstructed structures

### Description:

In the framework of the project, the fish passes at Ambrožev trg and the Fužine weir, the weir at Zalog, the gate lifting system, and the sluice gate Ambrožev trg were restored. Above the sill in Zalog there is an oxbow which was disconnected with the main river channel during the low flows. The interrupted inflow of fresh water caused very poor living conditions for animals in the oxbow. The raise of the sill helped to improve this situation. The fish passes included in the project are very old and protected as cultural and technical heritage. None worked properly and due to the protection no major and drastic measures were allowed. With smaller improvements such as reconstruction of damaged steps in the interior and the installation of elements preventing the entry of floating debris at the inflow we managed to re-establish their operation. The lifting system of the barrier at the Ambrožev trg gate was outdated and did not allow the precise regulation which is important for regulating the water level through the city centre all the way up to Ljubljansko barje. Too fast raising of the barrier instantly caused deterioration of ecohydrological conditions downstream. With modernization of the electromechanical equipment the situation is improved.

### Motivation:

Prior to the restoration works, the structures were neglected and poorly maintained; therefore in the future we will check the condition of the reconstructed structures and infrastructures and, if necessary, draw attention of the responsible institutions to the mistakes. Because the gates at Ambrožev trg could not be upgraded in the extent originally foreseen, while the need for upgrading or replacement was also advised by experts, one of the objectives is also to encourage the upgrading/replacement of the entire sluice gate at Ambrožev trg.

### Objectives:

- Encouraging the idea of restoration/replacement of the entire sluice gate at Ambrožev trg.
- Handover of the upgraded gate lifting system to Ministry of Environment and Spatial Planning operation.
- Checking of the condition of the reconstructed bank and sill at Zalog.
- The checking of the condition of the fish passes at Ambrožev trg and the Fužine weir.



	<b>Measure</b>	<b>Responsible</b>	<b>Necessary funds</b>	<b>Timeframe</b>
1	Encouraging the restoration or replacement of the entire sluice gate at Ambrožev trg.	UL FGG, Geateh, Purgator	Part of regular tasks.	As needed.
2	Checking of the condition of the reconstructed bank and sill at Zalog.	UL FGG, Geateh, Purgator	Transportation costs, approx. 30 EUR/year	Continuous (1 or 2 per year).
3	The checking of the condition of the fish passes at Ambrožev trg and the Fužine weir.	UL FGG, Geateh, Purgator	Transportation costs, approx. 30 EUR/year	Continuous (1 or 2 per year).
4	Operation of the system handed over to MOP.	UL FGG	Part of regular tasks.	2016



### 3 SUMMARY

The focus of the After-LIFE Conservation Plan of Ljubljana Connects is to continue the implementation of the individual actions of the project as well as dissemination of results and experiences. The main objectives of the After-LIFE Conservation Plan are: continuation of monitoring of the passage of fish through fish passes using a two-camera system and improving the method itself, continuation and maintenance of ecohydrological monitoring at 17 hydrometric stations and 3 online stations and the use of these data for various purposes, dissemination of results, informing about the significance of preserving the good status of streams and target fish species, networking with similar projects encouraging conservation measures allowing for fish migrating in upstream parts of rivers, and surveillance or checking of the condition of the structures reconstructed in the project.

For most of the measures no major financial input is required; in fact, some activities will be included into regular duties of the beneficiaries. The principal costs of maintaining ecohydrological monitoring and the monitoring of fish migration are travel expenses and the costs of necessary repairs and new equipment. The responsibility for implementation of the measures is divided as to the type of work or content during project's implementation, so most measures are taken over by UL FGG.

We would have liked to see the participation of other institutions already during the project, such as the Fisheries Research Institute of Slovenia, responsible ministries, ARSO, MOL, that would, in the after-Life period, help us achieve some of the goals set or even upgrade our work so far. To a small degree, MOL will take part in dissemination and MOP the handing over of the gates.

Given the many problems, much was achieved in this project, and we are particularly proud of the products that we developed on our own. We recognise the value of the work achieved and want to continue doing it. We are committed to do this as long as possible and involve new staff and the means necessary.





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**Lead partner:**

University of Ljubljana, Faculty of Civil and Geodetic Engineering



Univerza v Ljubljani  
Fakulteta za *gradbeništvo in geodezijo*

**Associated partners:**

Geateh d.o.o.  
Purgator d.o.o.



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## ABOUT THE AFTER-LIFE CONSERVATION PLAN

LIFE+ Nature projects must produce an After-LIFE Conservation Plan that sets out how conservation activities are planned to continue and to develop after the end of the project, and how the longer-term management of the site(s) will be assured. It should give details regarding what actions will be carried out, when, by whom, and using what sources of finance.