

*Restoration of *Unio crassus* rivers in the Luxemburgish Ardennes LIFE11 NAT/LU/857*



September 1st
2012 – February
28th 2019

Final Report



LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère du Développement durable
et des Infrastructures
Département de l'environnement



LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de la Viticulture et de la
Protection des consommateurs





LIFE11 NAT/LU/857

FINAL Report

Covering the project activities from 01/09/2012 to 28/02/2019

Reporting Date

15/05/2019

“Restoration of Unio crassus rivers in the Luxemburgish Ardennes”

Resto-unio

Project Data

| | |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Project location: | Vallée de l'Our de Ouren à Dasburg Pont LU0001002 Vallée Supérieure de la Sûre / Lac du barrage LU0001007 |
| Project start date: | 01.09.2012 |
| Project end date: | 28.02.2018, Extension date: 28.02.2019 |
| Total Project duration (in months) | 78 months (including Extension of 12 months) |
| Total budget | 2.057.068 € |
| Total eligible budget | 2.057.068 € |
| EC contribution: | 1.028.534 € |
| (%) of total costs | 50% |
| (%) of eligible costs | 50% |

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2 EXECUTIVE SUMMARY

The document and its annexes represent the final report of the LIFE project “Restoration of *Unio crassus* rivers in the Luxemburgish Ardennes” LIFE11/NAT/LU/857. For additional information on the evolution of the different aspects of the project, the progress reports can be consulted on the project’s website: www.unio.lu.

The LIFE Resto Unio was a LIFE + Nature project carried out in the northern part of Luxembourg and focused on the thick shelled river mussel (*Unio crassus*, code 1032). The thick shelled river mussel a formally abundant species of semi lentic river habitats shows a dramatic decline within its distribution range and also in its two remaining populations in Luxembourg, in the river Our and the river Sûre. One crucial problem of many river systems in central Europe is the heavy load of fine sediments causing a clogging of the interstitial pore system, the key habitat used by juvenile mussels during the first years and the eutrophication of the river.

The aims of the project was therefore the improvement of the habitat quality by reducing the load of sediment in river systems, reducing nutrient input and the strengthening of the existing populations.

- An initial mapping of the "hot spots" (action A1) was done on both river catchments to localize the main sediment entrances to the rivers Our and Sûre and their tributaries.
- Priority lists were elaborated by evaluating and rating the detected problems. These priority lists helped to decide which measures had to be implemented. The priority lists were summarized in the "restoration measure plan" (action A2). These restoration measures were executed under the C1-C3 actions.
- Complementary to the "restoration measure plan" we defined parameters (action D4) to be measured to establish the initial status of the habitat quality and to allow the follow up of the restoration effect.
- As for both Natura 2000 areas, Our and Sûre, no management plan existed before the start of the project, we were supporting the elaboration of such a plan with our knowledge on the aquatic species of both river catchments. These plans are now finalised and have been officially published by the national authority.
- With land acquisition we were able to protect valuable areas within the project perimeter.
- The practical restoration work, consisting of reducing the entrance of fine sediments, removing fish migrating obstacle and improving the river substrate were executed under action C1. C2 and C3 with positive results.
- To strengthen the mussel populations, a breeding technique for the thick-shelled river mussel was developed within this project by us and is applied at the rearing facility at the mill of Kalborn. This method is detailed in a written document (action A4 & C4). Furthermore, the impact of invasive species on the mussel population was reduced by trapping the muskrat and the signal crayfish (C5) together with the support of the national authority.
- A monitoring of the water quality and the interstitial pore system was performed in the target rivers.
- In both rivers, Our and Sûre, we investigated the status quo of the mussels: population density, population structure, vitality, gravidity and the substratum quality (action D3) as well as the fish population.

- Special attention was paid on informing the basin's actors, mainly land-users and water managers (national and trans-boundary) to facilitate the collaboration and the data exchange.
- At the end of the Project, 8.284 people had visited the rearing station or were informed during other events about the importance of freshwater ecosystems.

2.1 Administrative part

The project team was nominated and the different tasks were assigned to its members at the beginning of the project. However, due to personal reasons several changes occurred during the project. A management and accounting system was installed and managed by the secretary-accountant and the project coordinator. Regular team meetings and meetings with the piloting committee and the monitoring team took place. These meetings enabled to discuss the progress of the project and potential difficulties.

No major problems occurred with the project's management and accounting.

Technical progress

Table 1: Overview over actions and their results

| Action | Results |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Actions A | |
| Action A1: Localisation and mapping | The hotspots were evaluated, rated and priority lists to reduce the entrance of fine sediments into the watercourses were set up. Action A1 was finalised in May 2014. |
| Action A2: Planning of restoration measures | For each hotspot (A1) a restoration measure was developed. A "Restoration measure plan" was worked out and the report was sent to the European Commission on June 30 th 2014 and annexed to the mid-term report. This measure plan was used to plan and organize the different C actions. |
| Action A3: Planning of water quality and interstitial substrate survey | The planning of the water measurement stations and the other equipment needed for the water survey was part of this action. The redox-electrode allowing the survey of the interstitial substrate was delivered in January 2013. An online monitoring system "Our" was installed at the Mill in Kalborn in September 2013. A mobile online monitoring system was delivered in March 2014 and is used on the Sûre and its tributaries. |

| | |
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| Action A4: Elaboration of a rearing method for <i>Unio crassus</i> | By visiting rearing facilities for freshwater mussels in the USA, and following many discussions with experts, the already existing experience in rearing the Freshwater Pearl Mussel (<i>Margaritifera margaritifera</i>) was adapted to the thick shell river mussel (<i>Unio crassus</i>). A rearing protocol (first in German) was elaborated and sent to the European Commission with the mid-term report (Annex 5). The English translation of this report was attached to the Progress Report III (Annex 1) as well as published on the LIFE project website. |
| Action A5: Input to the elaboration of Natura 2000 "Our" and "Haute Sûre" management plans | Contribution to the management plans for the two Natura 2000 project areas on the river Our und Sauer was promised. The LIFE team gave scientific assistance with the focus on the aquatic fauna as foreseen. The plan for "Our" was published in May 2016 and "Sauer" in January 2017. The minister confirmed both plans in October 2018 (arrêté ministériel: http://data.legilux.public.lu/file/eli-etat-adm-amin-2018-10-11-b3544-jo-fr-pdf.pdf and https://environnement.public.lu/dam-assets/documents/natur/natura2000/LU0001007-LU0002004.pdf). |
| Actions B | |
| Action B1: Acquisition of land on the Our and Sauer rivers and on their tributaries | 14,01 ha of meadows, wood and agriculturally used land were acquired through the project. |
| Actions C | |
| Action C1: Interventions to reduce the fine sediment load to the rivers systems | (1) 2.365 m were fenced, 8 watering tanks and 4 cattle passages were constructed. (2) 63 water evacuation grids were installed next to 5 different streams. (3) 20 agri-environmental contracts and 62 biodiversity contracts were signed. (4) 520 m riverbed were restored and stabilized. |
| Action C2: Transformation of fish migration obstacles on the tributaries | 7 obstacles were removed within the project and 1 obstacle was done outside LIFE. In total 9.600 m streams were reopened for migration of fish and other aquatic organisms. |
| Action C3: Improvement of the riverbed by gravel input | The intention of this action was to improve the quantity and quality of the river substratum in both rivers by the creation of clean gravel depots at several sites in each sites. In total 1.038 m ³ (corresponding to 1.869 tons) gravel were dumped into the rivers. The gravel created new gravel banks with a surface of more than 2.500 m ² . |
| Action C4: Breeding <i>Unio crassus</i> for the "Grande Région" | During the project time 6 infestation cycles were done: (1) 9.197 fish (<i>Phoxinus phoxinus</i> , <i>Cottus gobio</i> , <i>Salmo trutta</i> , <i>Gasterosteus aculeatus</i> , <i>Squalius cephalus</i>) were infested |

| | |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>(2) 2.280 fish were released in cages</p> <p>(3) 6.917 fish were used in the collecting system</p> <p>(4) 151.772 juvenile mussels were collected</p> <p>(5) 1.916 cultivated mussels were released into the river Our and Sauer in 2018. 2.000 more mussels from the LIFE project will be released in summer 2019.</p> |
| Action C5: Capturing of muskrats | <p>Since 2012 the muskrats (<i>Ondatra zibethicus</i>) are captured by two persons from the ANF during the whole year. More than 400 animals could be captured in the last 6 years. Additional more than 13.700 Signal-crayfish (<i>Pascifastacus leniusculus</i>) were captured.</p> |
| Actions D | |
| Action D1: Water quality and interstitial substrate survey | <p>Once a week a sample from each river was taken and analysed. Once per season, or if necessary more often for investigative monitoring, the tributaries were sampled as well. The parameters temperature, pH value, conductivity, turbidity, oxygen concentration, ortho-phosphate, nitrite, ammonium and nitrate were determined. During the project more than 3.700 samples were analysed.</p> |
| Action D2: Host fish monitoring | <p>The fish population in both rivers, Our and Sauer was analysed in 2013, 2015 and 2017 and the natural infestation rate with <i>Unio crassus</i> glochidia was checked on 3 fish species (Minnow, Bullhead and Stickleback). On 8 tributaries at the river Our and 3 tributaries at the river Sauer the fish population was investigated by electric fishing. The effectiveness of the fish migration obstacle removal was checked by electric fishing. For three obstacles, we could proof the effectiveness.</p> |
| Action D3: <i>Unio crassus</i> monitoring | <p>The mussel survey was finished for the river Our in the year 2017 and for the river Sauer in 2018. In total 49 km were prospected and more than 7.000 alive mussels were found. Estimation of the recovery and survival rate was done with 1.115 marked mussels at 7 different places. Sediment analysis of the natural habitat was done every year.</p> |
| Action D4: Monitoring and evaluation of measures | <p>The success of the restoration measures was evaluated by the following indicators: water quality, turbidity, quality of substrate and the host fish population. These parameters are used as reference for the evaluation of prospective measures. The success of the breeding station is evaluated by the survival and growing rate of the mussels until they are released into the river.</p> |
| Action D5: Analysis of the socio-economic impact of the project and of the effect on the ecosystems | <p>An in-depth study of the socio-economic impact and ecosystem services impact was carried out by LIST using InVEST and TEV respectively.</p> |
| Actions E | |

| | |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action E1: Information and awareness of the concerned actors | This action intended to inform all actors responsible for water quality in the river catchment and tried to motivate them to help to enhance the water quality. 4 trans-border seminars with the focus on the water quality were organised. Additional 5 events for farmers were offered to discuss the topics: erosion, pesticides, soil and agri-environmental-measures. |
| Action E2: Public awareness | Public awareness consisted in kick-off meetings, press release, project flyer in 3 languages, 2 notice boards, a film, an exhibition room and the layman report. Furthermore, the team participated at different events to present the project. In total about 8.284 people were informed during the project run time. |
| Action E3: Design of a web site | The final website in three languages is online since June 2013 and is updated at least once a month. Visit: www.unio.lu |
| Action E4: Organisation of conferences | The first international seminar was on the 24 th to 27 th November 2015 with 81 participants from 20 countries. Three years later, the second international seminar was organised on the 27 th to 29 th November 2018 with 56 participants from 15 countries. |
| Actions F | |
| Action F1: Project management | See administrative part (chapter 3 below). |
| Action F2: Knowledge exchange: with LIFE and other projects | Regular exchange with other projects working with freshwater mussels (LIFE and others) occurred during the whole project time. At least once per year a team member participated at a scientific meetings and presented the project. |
| Action F3: After-LIFE conservation Plan | The After LIFE conservation plan was written in September 2018 and defines the management in the LIFE Resto-Unio area for the next five years. |

2.2 Acronyms

| | |
|---------|-------------------------------------------------------------------------------------|
| ACT | Administration du Cadastre et de la Topographie |
| AEM | agro-environmental measures |
| AGE | Administration et gestion de l'eau |
| ANF | Administration de la Nature et des Forêts |
| ASTA | Administration des services techniques de l'agriculture |
| COFIL | Comités de pilotage Natura 2000 |
| FMCS | Freshwater mollusk conservation society |
| IBLA | Institut fir biologesch Landwirtschaft an Agrarkultur Luxemburg |
| InVEST | Integrated Valuation of Ecosystem Services and Trade-offs |
| LIST | Luxembourg Institut for Science and Technology |
| LPD | Land purchase database |
| MA | Ministère de l'Agriculture, de la Viticulture et de la Protection des Consommateurs |
| MDDI | Ministère du Développement durable et des Infrastructures |
| MIGR | Ministère de l'Intérieur et à la Grande Région |
| n&ë HfN | natur&ëmwelt Fondation Hëllef fir d'Natur |
| PDR | plan de développement rural |
| RNA | Reserve naturelle agréée |
| U.c. | <i>Unio crassus</i> |
| TEC | Total Economic Valuation |
| WFD | Water framework Directive |
| ZPIN | zones protégées d'intérêt national |

3 INTRODUCTION

3.1 Description of background, problem and objectives

3.1.1 OVERALL AND SPECIFIC OBJECTIVES

The loss of biodiversity in aquatic ecosystem continues, both internationally and within Luxembourg. Various habitats are in a critical state, and suffer from different forms of degradation: such as, agricultural changes, hydro morphological alterations of surface water bodies (e.g. dams and weirs; irregular flow patterns), waste water contamination and source pollution.

The thick-shelled river mussel *Unio crassus*, a formerly abundant species of semi lentic river habitats, shows a dramatic decline within its distribution range. Whereas until the 1970th, the species was present in nearly all the watercourses in Luxembourg, nowadays only two populations remain in the river Our and the river Sauer, in the northern part of Luxembourg. The aims of the project was to improve the habitat quality of *Unio crassus* as a flagship species and to strengthen the population especially with breeding measures.

3.1.2 INVOLVED SITES

- LU0001007 Vallée supérieure de la Sûre / Lac du Barrage (43,63 km²)
- LU0001002 Vallée de l'Our de Ouren à Wallendorf Pont (56,75 km²)

3.1.3 TARGETED SPECIES

Thick shell river mussel - *Unio crassus* (Philipsson 1788)



Figure 1: *Unio crassus*

3.1.4 MAIN CONSERVATION ISSUES

Threat1: insufficient number of mussels

The last monitoring done in the years 2001-2004 showed that young mussels with an age under 4 years are present in insufficient numbers. With only 30.000 mussels in the river Sauer and only 9.000 mussels in the river Our, the populations risk to disappear.

*“One key action of the project is to develop captive breeding methods for *Unio crassus* and to release propagated animals at both sites to strengthen the old population with young individuals.”*

As the thick-shelled river mussel has a parasitical phase on a host fish. The host fish need to be present in sufficient numbers to enable the mussels to complete their life cycle. However, on many tributaries, culverts cut off the watercourses disabling the fish to migrate into these tributaries for spawning.

*“Improving the connectivity of the river system by removing migration obstacles in smaller tributaries will enhance the host fish population (e.g. *Phoxinus phoxinus*, *Cottus gobio* and *Salmo trutta fario*).”*

Additionally, the muskrat (*Ondatra zibethicus*), a non-native species, is locally destroying mussel banks by feeding on them. A recent monitoring showed additionally the presence of the signal crayfish *Pacifastacus leniusculus*, having as well a negative impact on the mussel population.

*“The unnatural predator pressure on *Unio crassus* by these alien species will be reduced by regulating their population density.”*

Threat 2: insufficient water quality

The intense use of agricultural land leads to heavy loads of fine sediments and to eutrophication in the watercourses. Locally the cattle trampling near the brooks contribute to a destabilisation of the banks and cause a further input of excrements and fine sediments into the water. This leads to insufficient conditions in the substratum, where juvenile mussels grow up.

“Installing fences along the river and tributaries will protect the vegetation, stabilize the banks and reduce erosion.”

“The selective installation of water evacuation grids on agricultural and forestry roads will prevent the runoff of sediment loaded water from running directly into the watercourses.”

“The negotiation of agri-environmental measures will reduce the amount of nutrients and help in decreasing the impact of fines.”

3.1.5 SOCIO-ECONOMIC CONTEXT

The project area is located in the north of Luxembourg where agriculture is the main actor concerning land use. To support the local population, we mainly commissioned the external assistance to local companies.

For building our fences, watering places and cattle passages, we charged CNDS. CNDS is a social structure helping socially disadvantaged people to find a way back into the working life.

During the project time the cooperation with the administrations (AGE and ANF), the local farmers and the Naturpark Our and Sauer increased. This created a very good network for further projects.

Public awareness increased during the project time. The new Natura 2000 room and the environmental- and water-education at the mill of Kalborn gave to a lot of pupils, students and others the opportunity to learn more about Natura 2000 and its habitats.

3.2 Expected longer term results

The main objective of the project was to strengthen the *Unio crassus* population in the river Our and Sauer. This objectives should be reached with different measures as habitat restoration, increasing the water quality and the breeding of the mussels (actions C1 to C5). The main goal of these measures was to reduce the load of fine sediments and nutrients in the river system.

The project had most probably a positive impact on the thick shelled river mussel *Unio crassus* as well as on many other Annex II species of the Habitats Directive sharing the same aquatic habitat, such as *Margaritifera margaritifera*, *Cottus gobio*, *Salmo salar*, *Lampetra planeri*, *Oxygastra curtisii*, *Lutra lutra*. Creating cleaner and less clogged gravel within the river will certainly improve the self-cleaning capacity of the river and therefore highly improve the ecosystem services provided by the respective rivers.

Mussels were released at selected sites in each river system. A strong mussel population offers a strong ecosystem service to a river by its filtering capacity, by biodeposition and thus making food available to other benthic animals.

The project was planning to remove 7 migrating obstacles and reconnected 9,5 km of tributaries with the main stream. Bullhead and brown trout will surely benefit from the opening of these stretches that will indirectly have a positive effect on the mussel's populations as well.

Besides, the acquisition of more than 8 ha (objective largely exceeded in the end) of land will enforce the existing network of land dedicated to nature conservation on both catchments.

A more detailed description of long-term results is available in chapter 5.4.

4 ADMINISTRATIVE PART

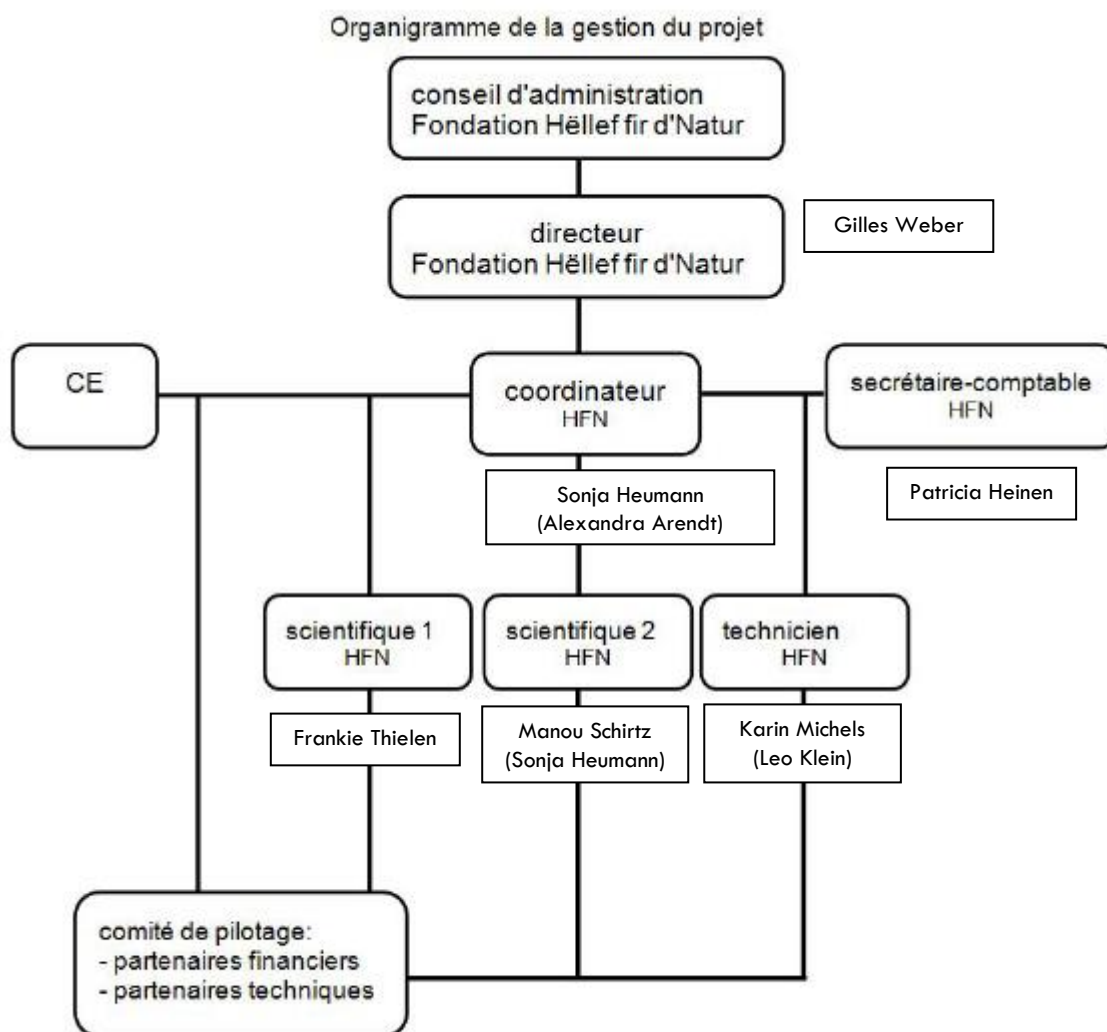
4.1 Description of the management system

4.1.1 CONSTITUTION OF THE PROJECT TEAM

| Position | % | Name |
|----------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------|
| Regular team | | |
| Coordinator | 70% | Sonja Heumann Dr. tech. (01/2017 – 02/2019) |
| | 60% | Alexandra Arendt MSc biologist (09/2012 – 12/2016) |
| Scientific 1 | 50% | Frankie Thielen Dr. rer. nat. and 50% on a non EU project (09/2012 – 02/2019) |
| Scientific 2 | 70% | Manou Schirtz, MSc, 20% LEADER: Wassererlebniszentrum Kalborner Mühle (EL 19-2 Nr, 6), 10% on a non EU project (03/2017 – 02/2019) |
| | 50% | Sonja Heumann Dr. tech (10/2012 – 12/2016) |
| Technician | 100% | Karin Michels (01/2015 – 02/2019) |
| | 100% | Leo Klein (10/2012 – 12/2014) |
| Secretary/ accountancy | 40% | Patricia Heinen (09/2012 - 02/2019) |
| Punctuated help (details see 0) | | |
| 09/2012 – 02/2019 | | Gilles Weber, director of n&e HfN |
| 04/2016 – 03/2017 | | Tanja Eybe, Dipl. Biol., n&e HfN |
| 06/2018 – 02/2019 | | Mireille Molitor, MSc biologist, n&e HfN |
| 03/2018 – 02/2019 | | Claude Schiltz, MSc cartographe, n&e HfN |
| 07/2018 – 02/2019 | | Nicolas Hormain, relations publiques, n&e HfN |

4.1.2 ALLOCATION OF THE DIFFERENT MISSIONS TO EACH TEAM MEMBER

| Name | Position | Action |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Current team members | | |
| Sonja Heumann | In charge with the project coordination, the water quality survey, the planning, realisation and monitoring of the measures | A1, A3, B1, C1, C2, C3, D1, D3, D4, E1, F1, F3 |
| Frankie Thielen | Responsible for the rearing station and the tasks related to the mussel breeding, mussels and fish monitoring, public awareness and scientific seminars | A4, C4, C5, D2, D3, D4, D5, E1, E2, E3, E4, F2, F3 |
| Manou Schirtz | Realisation of measures in the agricultural context, the preparation of maps and the leaflet for the farmers | C1, E1, E2, F3 |
| Karin Michels | Responsible for the rearing station and the tasks related to the mussel breeding and water quality monitoring | C4, D1, D2, D3, D4 |
| Patricia Heinen | Accounting, timesheets and correspondence | B1, F1 |
| | Each team member contributes in informing the public. Whenever an action needs higher personal input the other team member gave their support. | E1, E2 |
| Former team members | | |
| Alexandra Arendt | In charge with the coordination of the project, the realisation of measures in the agricultural context. | A2, A3, A5, B1, C1, C3, C5, D3, E1, F1 |
| Leo Klein | Responsible for the rearing station and the tasks related to the mussel breeding | A1, C4, D1, D2, D3, D4 |
| Punctuated team members | | |
| Gilles Weber | Management and contact to "Conseil d'administrative" | B1, F1 |
| Tanja Eybe | Realisation of the Natura 2000 room and the notice boards | E1, E2 |
| Mireille Molitor | Realisation of the layman report and leaflet for farmers | E1, E2 |
| Claude Schiltz | Land purchase, measures on new bought land, EU database for land purchase (LPD) | B1, F1 |
| Nicolas Hormain | Leaflet for the farmers and layout of layman report | E1, E2 |



PROJECT MANAGEMENT AND ACCOUNTING

The project coordinator and the secretary-accountant were primarily responsible for the well-functioning of the administrative part of the project. The coordinator was responsible for the follow-up on the inputs and outputs and the coordination with the European Commission. Furthermore, the coordinator was responsible for the adherence of the time schedule and the execution of the actions in accordance with the project's objectives. The coordinator was in regular contact with Gilles Weber, the director of n&e HfN, who is responsible for the contact with the administrative council and acts as an advisory in several matters.

The secretary-accountant was responsible for the daily financial and administrative works.

The VAT statement was submitted with the inception report (see annex 1). The VAT status of natur&ëmwelt HfN did not change since the beginning of the project. Officially, natur & ëmwelt HfN is "Non – Assujetti à la TVA".

The procedure for tendering has changed during the project. The threshold values proposed in the "protocole Guidant lapel d'offre pour n&e Fondation Hellef fir d'Natur" submitted at the beginning of the project were much lower than required both by national law and by common provision of the LIFE programme. The low limits impeded the progress of the LIFE project as 3 offers were required even for small implementations. A circular informed the staff of n&e HfN of the new procedures to adhere to (see annex 2).

The project was organised by regular meetings.

- Every Monday 15 minutes team meeting: information about the happenings for the coming week (meetings, fieldwork, help needed for special tasks...)
- Monthly team meetings (1 to 2 hours): review of the task's progresses, discussion of problems, working out of solutions.
- Monthly meeting with the Fondation Hëllef fir d' Naturs' director: validation of work content and proceeding (written reports).
- Monthly meeting between the director and the administrative council of Fondation Hëllef fir d'Natur. If necessary aspects dealing with the LIFE Unio project are mentioned (written reports).
- Meetings with stakeholders or other groups and people relevant for the project management are always mentioned in the respective description of the action (see chapter 5).

The members of the piloting committee were assigned at the beginning of the project.

| Insitution | Name |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ministère de l'Environnement, du Climat et du Développement durable | Nora Elvinger, Sandra Cellina |
| ANF - Administration de la nature et des forêts | Robert DuFays, Jan Herr |
| AGE - Administration et gestion de l'eau | Phillipe Luty, Nora Welschbillig, Carole Molitor, Claude Neuberg, Olivier Jeitz, Jean-Marie Waltzing |
| Naturpark Our | Eva Rabold, Laurent Spithoven |
| Naturpark Oewersauer | Frank Richarz |
| ASTA - Administration des services techniques de l'agriculture | Pascal Pelt, Marc Weydart |
| Chamber of Agriculture | Ben Geib, Thierry Kozlik, Gilles Parisot |
| n&e Hfn | Sonja Heumann, Patricia Heinen, Frankie Thielen, Manou Schirtz, Karin Michels, Alexandra Arendt, Leo Klein, Mireille Molitor, Frantz Charles Muller, Claude Meisch |

Yearly meetings with the piloting committee were hosted by the LIFE Resto Unio project:

30.11.2012, 10.07.2013, 01.10.2014, 09.12.2015, 14.12.2016, 15.01.2018, 11.02.2019

4.1.3 AMENDMENTS TO THE GRANT AGREEMENT

- The name Fondation Hëllef fir d'Natur changed to natur&ëmwelt-Fondation Hëllef fir d'Natur but the statutes did not change (see statute of n&ë HfN in annex 3).
- The first march 2015 natur&ëmwelt-Fondation Hëllef fir d'Natur got a new president, namely Mr. Patrick Losch.
- The project submitted on 27.05.2016 a request for prolongation, which was granted by the EC on 21.07.2016. The end of the project was postponed to 28.02.2019 (see annex 4)

4.1.4 PARTNERSHIP AGREEMENTS

- The Partnership agreements with MA and MDDI were annexed to the Inception report - annex 10 while the one with MIGR was submitted with the Progress report I - annex 20. All agreements can be found in annex 5.

4.2 Evaluation of the management system

4.2.1 EVALUATION OF PROJECT MANAGEMENT PROCESS

There is no partner in the project so the beneficiary is acting by himself.

The project coordination changed in December 2016. Alexandra Arendt took over the coordination of other projects within our NGO. Starting from January 2017, Sonja Heumann took over the coordination of the project. She increased her weekly hours from 20 to 28 per week.

There was also a change of the technician person. Leo Klein quitted his job in December 2014 and was replaced by Karin Michels in January 2015.

The project's staff has to execute the daily project's management. As, with the exception of the technician, all other members have partial tasks, the regular communication between the team members is very important. The weekly short meetings helped in organizing the coming week and in considering eventual problems as soon as they occur.

In general, we had very constructive exchanges with the members of the pilot committee. They were supporting the project well. When we were asking to give a more political statement to the competent Ministers, meetings were organised and the problems encountered were discussed openly.

4.2.2 COMMUNICATION WITH THE COMMISSION AND MONITORING TEAM

The project coordinator was in regular contact with the monitoring team (Mr Tom Andries/ Mr Thomas Wouters) and the representatives of the EC (Mr Simon Goss, Ms Muriel Drukman) concerning any problems or desired changes.

In case of questions, we were first contacting the external monitoring team that was quickly giving us the requested answers. We also appreciated that the Commission was very close to the project and supported us in approaching problems on the national governmental level. We can consider this to have been a well-functioning supporting system.

Contact and submission of information was by several means:

- Participation to the kick-off-meeting in Paris – 25.10.2012
- Welcoming of the external monitoring team (Mr Tom Andries/ Mr Thomas Wouters)
 - 12.12.2012, 18.11.2013, 03.11.2014, 03.09.2015, 19.09.2016, 06.11.2017, 12.09.2018

- Welcoming of Mr Simon Goss on 03.09.2015
- Regular contact with the external team by mail or phone
- Submission of inception report, progress reports, mid-term report and final report

| Date - sent | Report |
|-------------|---------------------|
| 28.02.2013 | Inception report |
| 27.02.2014 | Progress report I |
| 25.03.2015 | Midterm report |
| 23.03.2016 | Progress report II |
| 08.03.2017 | Progress report III |
| 06.03.2018 | Progress report IV |
| 15.05.2019 | Final report |

We gave an answer to all the questions, which arose in all the letters from the external team and EC. The answers can be found in annex 6.

5 TECHNICAL PART

5.1 Technical progress, per task

5.1.1 ACTION A1: LOCALISATION DES ZONE A RISQUES D'ÉROSION

5.1.1.1 Expected results

The action focuses on the mapping of “Hot spots” and creating a list with these spots, the concerning parcel number, the owners and users.

5.1.1.2 Activities and outputs

Mapping started in October 2012 with the tributaries of the river Our, followed by forestry roads around the river Sauer and farmland in the river Sauer catchment. In May 2014 the mapping was finished.



Figure 2: Mapping of the tributaries of Our and Sauer

The hotspots have been evaluated, rated and priority lists have been set up for all types of entrances of fine sediments into the water courses. As requested in your letter ENV.E3 SG/LM/sp from 23.12.2015 we updated our “Restoration measure plan” which includes the erosion risk areas and maps (see Action A2).

5.1.2 ACTION A2: PLANIFICATION DES MESURES DE RESTAURATION

5.1.2.1 Expected results

The initial mapping phase of “hot spots” of erosion, as foreseen under the action A1, allowed the project team deciding where negative points have to be resolved and have led to the concrete planning phase of the following restoration measures:

- The installation of 2 km of fences, 5 cattle watering installations, 3 bridges for cattle.
- Removal of 6 fish obstacles
- Construction of 60 water evacuation systems on agricultural and forestry roads.
- 40 agro-environmental measures
- Restoration of a river bed

5.1.2.2 Activities and outputs

After finishing and already during the mapping the project team started with the formulation and the planning of restoration measures; first with the identification of landowners in order to establish contact for land purchase or the implementation of restoration on their land. The 2014 priority list contained specific information on problems identified, their localisation, a link to www.geoportail.lu and a description of adapted restoration measures. The list as well as the measures are compiled in a written document called “Restoration measure plan” enclosed to this report (see annex 7) but already annexed to the mid-term report - annex 1.

Places to dump in the gravel were selected (4 resp. 5 places each river).

Table 2: Number of potential measures in “Restoration measure plan”

| Type of measures | Number of potential measures |
|----------------------|------------------------------------------------------|
| Farmland | 20 |
| Evacuation grids | 15 |
| Installing fences | 4 km |
| Fish obstacles | 57 |
| Gravel input | 4 places at river Our 5 places at the river Sauer |
| Riverbed restoration | 1 |

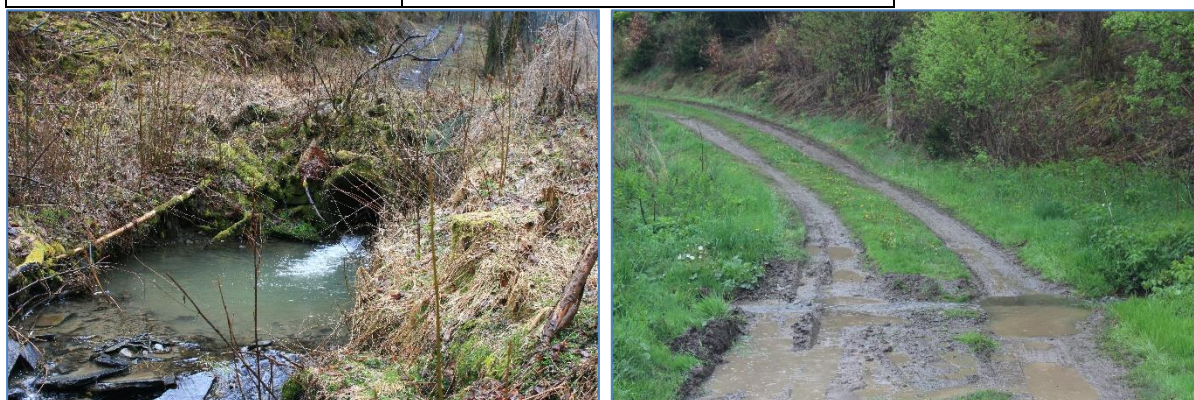


Figure 3: left: Hotspot regarding fish obstacle, right: hotspots regarding erosion

To plan the concrete actions, contact with the concerned authorities, such as municipalities, the Administration of water management (AGE) and the Administration of nature and forest (ANF) was

necessary throughout the project. The action of removing the fish obstacles required authorisations, which were requested and granted from the responsible administration and municipalities.

The priority list was updated and maps were elaborated. The new list has no links, referring to the national geoportal, anymore as the links are only valid for one year. The new document is called "Restoration measure plan 2019". (see annex 8)

5.1.2.3 Time schedule

| A2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.2.4 Indicators

| Deliverables/ milestones | Deadline | Progress |
|----------------------------------|------------|-------------------------------------------------------------------------------|
| Plan des mesures de restauration | 30.06.2014 | The planning of concrete measures has continued until the end of the project. |
| | 28.12.2019 | "Restoration measure plan 2019" |

5.1.2.5 Technical and / or financial modifications and justifications

No modifications or justifications were necessary.

5.1.2.6 Problems encountered

No problem encountered.

5.1.2.7 Outside LIFE

Removing a fish obstacle at stream "Feierbëch" (see C2) which was paid by the AGE.

5.1.2.8 Outlook

The action A2 is not part of the After LIFE Action Plan. Nevertheless, the planning of measures will be continued.

5.1.3 ACTION A3: PLANIFICATION DE LA SURVEILLANCE DE LA QUALITE DE L'EAU ET DU SUBSTRAT INTERSTITIAL

5.1.3.1 Expected results

The planning of the water measurement station and other equipment needed for the water quality survey is part of this action.

5.1.3.2 Activities and outputs

A redox-electrode (Geist & Auerswald, 2007) was delivered in January 2013. In March (04.03.2013) was a meeting in Munich combined with a workshop to learn the handling. In July 2014 another workshop was hold on the river Our.



Figure 4: Redox electrode

In June 2013 the company Hach-Lange installed 4 probes (nitrate, ammonium, chloride and potassium) at our Lab in Kalborn in order to see if the equipment would fit our needs. In August 2013 the whole equipment (nitrate, ammonium, chloride and potassium; conductivity, turbidity, oxygen and pH-value) was ordered and installed in September 2013.



Figure 5: Online measurement system at Kalbornermillen

A second system (OTT) was installed in March 2014. This is a mobile online monitoring system with several parameters (temperature, pH value, oxygen, conductivity, turbidity and nitrate). It is used for the monitoring on the river Sauer and its tributaries and to evaluate the planned measures.



Figure 6: Mobile measurement system at the tributary Syrbaach and the mobile turbidity logger at Schwärzerbaach

We planned to buy two turbidity sensors. It is an important task to combine sediment boxes with a turbidity sensor to be able to evaluate the measures. This was granted by the EC in its letter dated on 07/11/2016 (Ares(2016)6287622). The logger was bought in 2015.

5.1.3.3 Time schedule

| A3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.3.4 Indicators

| Deliverables/ milestones | Deadline | Progress |
|-------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Installation des stations de mesure qualité eau | 30.06.2013 | The test period started in June 2013. The installation of the online measurement system at Kalbermillen was finished in September 2013. |

5.1.3.5 Technical and / or financial modifications and justifications

There was a slight financial modification because the turbidity loggers were planned under A3 but the budget was foreseen in D1. No modifications or justifications were necessary.

5.1.3.6 Problems encountered

No problem encountered.

5.1.3.7 Outside LIFE

None.

5.1.3.8 Outlook

No new equipment will be bought in future. The established online measurement system and the mobile systems will be used and maintained by Sonja Heumann.

5.1.4 ACTION A4: MISE EN PLACE DE LA TECHNIQUE D'ÉLEVAGE POUR UNIO CRASSUS

5.1.4.1 Expected results

The intent of this action is to plan and organise all the necessary steps to install a culture procedure for *Unio crassus* at the rearing facility at the mill of Kalborn.

5.1.4.2 Activities and outputs

Authorisation

All permissions from the MDDI to handle *Unio crassus* in the river Our and Sauer for the original project runtime (2012-2018) were organized. In January 2018 a new permission from the MDDI for the remaining project runtime and the After LIFE (February 2018 – February 2023) was requested and granted by the Ministry (see annex 9).

Developing and writing a rearing protocol

A rearing protocol including all the necessary steps for the culture of *Unio crassus*, including a discussion of the first results was written in German and is available online since August 2014. In 2016, the rearing protocol was translated into English and is since 2016 available online as well (see annex 10 and annex 11)

Exchange with experts from the USA

Meetings at the following mussel facilities in USA were arranged to learn the handling of the cell counter:

- Marion, Virginia Department of Game and Inland fisheries - Aquatic Wildlife Conservation Center, Virginia (Contact person, Megan Bradley).
- White Sulphur Springs, National Fish Hatchery and aquatic Resource recovery center, West Virginia (Contact person, Rachel Mair).

These meetings took place the week after the FMCS meeting in 2013 (18-21.03.2013).

An expert from the USA stayed two days (November 30th and December 1st, 2015) at our rearing facility after the seminar (see action E4) and helped us doing some more experiments with the cell counter. The expert who stayed was Megan Bradley from Marion, Virginia Department of Game and Inland fisheries - Aquatic Wildlife Conservation Center, Virginia.

5.1.4.3 Time schedule

| A4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.4.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|----------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rearing protocol | 31.08.2014 | <p>The rearing protocol was finalised in August 2014 but only in German.</p> <p>An English translation was done in 2016 upon EC's request.</p> <p>The protocol is now available in both languages online.</p> <p>DE: https://www.unio.lu/files/55852.pdf</p> <p>EN: https://www.unio.lu/files/72719.pdf</p> |
| Training to use the cell counter | 30.03.2013 | Took place the week after the FMCS meeting in 2013 (18-21.03.2013) |

5.1.4.5 Technical and / or financial modifications and justifications

No technical or financial modifications were necessary in this action.

5.1.4.6 Problems encountered

No problems encountered.

5.1.4.7 Outside LIFE

None.

5.1.4.8 Outlook

The exchange with different freshwater mussel rearing facilities in the USA and in Europe is still ongoing. This is mainly done by email and a list with the facilities and person we have regular exchange is listed in annex 49, dealing with action F2.

5.1.5 ACTION A5: CONTRIBUTION À L'ÉLABORATION DES PLANS DE GESTION NATURA 2000 "OUR" ET "HAUTE SÛRE"

5.1.5.1 Expected results

The management plans for the two project areas on the river Our and the river Sauer in the Natura 2000 sites should be elaborated as cooperation of the MDDI and natur&emwelt.

LU0001002 Vallée de l'Our à Wallendorf-Pont, LU0002003 Vallée de l'Our à Wallendorf-Pont, LU0001007 Vallée Supérieure de la Sûre/Lac du barrage, LU0002004 Vallée Supérieure de la Sûre/Lac du barrage.

The LIFE team itself gives scientific assistance to the person in charge of working out management plans. During public hearings, the team will contribute with details about the aquatic biotope.

5.1.5.2 Activities and outputs

In the year 2013 the ANF presented the new strategy for working out Natura 2000 management plans for Luxembourg. But till May 2013 no consultant office had been charged with the elaboration of the management plan Our and Sauer. To avoid a delay of this action natur&emwelt prepared an offer and proposal of a timetable. At the end of the year 2013 natur&emwelt was officially charged with the elaboration of both management plans. Richard Dahlem (Ecologist) supported by Stephan Müllenborn (Geographer) (both are not part of the regular LIFE Rest Unio team) worked out the management plans. The LIFE staff, as actor of the two areas, gave scientific assistance namely with the focus on the aquatic fauna as foreseen in the LIFE Grant Agreement.

In 2014, several meetings were organised to discuss the strategy and the layout.

In the beginning of 2015, a first draft version was prepared. The official deadline was November 2015.

In December 2015 the management plan for Natura 2000 Our was completed and was presented in January 2016 to the ANF, in February 2016 to the AGE and the Naturpark Our. The plan for Our was published in May 2016 on the internet site www.emwelt.lu

The management plan for Sauer was completed in March 2016 and published in January 2017 on the internet site www.emwelt.lu.

Both management plans were finally adopted and published as "arrêté ministériel" on 11.10.2018, before the project's end date. The government launched an administrative structure to implement the Natura 2000 management plans. In the north of Luxembourg the COPIL (Comité de pilotage, based in the Naturpark Our) is charged with this task and will carry on measures to improve the quality of the Natura 2000 areas. This structure will give our NGO the possibility to get funding for the implementation of concrete measures in the Natura 2000 area.



Figure 7: Management plans of Our and Saver (adopted)

Offer to ANF and response of ANF for the collaboration (Midterm report - annexes 6 and 7).

The final versions were sent with the progress III report - annexes 2 and 3)

The published “arrêté ministériel” – see annex 12 and annex 13.

5.1.5.3 Time schedule

| A4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.5.4 Indicators

| Deliverables/ milestones | Deadline | Progress |
|------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Plans de gestion Natura 2000 | 31.05.2016 31.01.2017 | The management plans of Our and Sauer were finished in March 2016. But the publication of the plan for Sauer had a delay (January 2017). |
| Adoption du de gestion Natura 2000 | 30.06.2017 11.10.2018 | The plans were adopted and published as an “arrêté ministériel” in October 2018. |

5.1.5.5 Technical and / or financial modifications and justifications

No modifications or justifications were necessary.

5.1.5.6 Problems encountered

After finishing the management plans, the administrations had to publish them on the internet site www.emwelt.lu that was done with a delay of half a year. The adoption and publishing as an arrêté ministériel” had a delay of more than a year.

5.1.5.7 Outside LIFE

The elaboration of the management plans were done Outside LIFE with people who did not work in the LIFE project. The ANF financed the work.

5.1.5.8 Outlook

The Natura 2000 management plans will guide the restoration works in Luxembourg for the next 10 years (2018-2028). The measures proposed in the management plans were coordinated with the objectives of the LIFE project. The plans will help to get the necessary funding for the implementation of these measures. Both plans were already used to develop the after LIFE action Plan. Furthermore, the function of the newly created COPIL (see above) is to push and follow the implementation of the respective measures presented in the NATURA 2000 management plans.

5.1.6 ACTION B1: ACQUISITION DE TERRAINS LE LONG DE L'OUR, DE LA SAUER ET DE LEURS AFFLUENTS

5.1.6.1 Expected results

It is foreseen to acquire 8 hectares of land on the river Our and the river Sauer.

5.1.6.2 Activities and outputs

A procedure for the acquisition of land was established with the acquisition committee of n&ë HfN. For each acquisition:

- a folder is prepared for the committee,
- validation of the acquisition by the committee is required,
- offer is presented to the landowner,
- when the landowner agrees to the offer, the notary is contacted,
- acquired land is protected as a land parcel in the ensemble of parcels owned by n&ë HfN.

In Luxembourg, there is no specific status for the parcels owned by natur&ëmwelt. The parcels are part of the European network of nature protection NATURA 2000 and are situated in natural protection zones (ZPIN : zones protégées d'intérêt national)

There is no RNA status, as this status is not included in the new law on the protection of nature.

The landowners in the project area were identified through collaboration with the Administration du Cadastre et de la Topographie (ACT).

A total of 14,0131 hectares of land was purchased (7,1228 hectares in the catchment area of the Sauer and 6,8903 hectares in the catchment area of the Our).

40 land-register-parcels were bought in 18 notary acts for a total amount of 88.367,49 €.

2 complementary notary acts were made to ensure the correct phrasing of the clause for nature protection in all notary acts.

The acquisitions will complement the land owned by n&ë HfN and will be managed to benefit the environment. Maps with the location of the purchased parcels (annex 14), the measures (annex 15), the NATURA 2000 area and the land already owned by the beneficiary are in the annex 16.

The notary acts are kept in paper form at the office and electronic format on the server of n&ë HfN. The electronic form is provided in the annex 17. The parcels were entered in the Land Purchase Database system (LPD).

5.1.6.3 Time schedule

| B1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.6.4 Indicators

In 2018 the target of 8 hectares was achieved.

The purchase of land has continued until the end of the project and is still continuing beyond the project's end date on own budget.

5.1.6.5 Technical and / or financial modifications and justifications

No technical or financial modification were necessary.

5.1.6.6 Problems encountered

Land purchase Line 20 & 21 & 25

In 2018 a lot of efforts were undertaken to purchase the catchment area of the source of the "Schawerzerbaach" near Bigonville.

As the LIFE UNIO-team was negotiating for these parcels, one landowner decided to sell its property entirely, 4 parcels were included in the LIFE UNIO land purchases (Landpurchase table Line 20 and 21 – in annex 15).

When signing the notary act, the LIFE UNIO Project decided to attribute the remaining balance of the budget, estimated at that moment to approximately € 17.000 to this land purchase.

The entire acquisition was started in order to prevent the local famer to change his use of the land from pasture to crop fields, as crops would be more beneficial to the farmer in the short term, as he feared losing the land to other famers in the nearby future.

The price for this acquisition was higher than the regular price, as it is composed mostly of pasture land in agricultural use, which has a higher price than the other acquisitions of the project.

The ownership of the land by natur&ëmwelt ensures both the long term conservation of this important ensemble of wet meadows, pasture, hedges and solitary trees, and also guarantees the local famer a long term use as pastureland.

A new leasing contract with extensification measures was signed in 2018, supplementary trees and hedges were planted, and new fences were build.

Supplementary acquisitions were undertaken. The second landowner of this catchment area decided to sell his land through a public auction. At this auction, natur&ëmwelt bought a neighbouring parcel (Landpurchase table Line 25).

In April 2019, 113,60 ares of pasture and wetlands in direct vicinity along the Schwaerzerbaach were send to the notary for the preparation of the notarial act.

Parts outside NATURA 2000:

Parcel 680/1526 is situated outside N2000 for 1,73 ares, ie. 2% of the notary act and 18% of the surface of the parcel

Parcel 703/7128 is situated outside N2000 for 46,28 ares ie 6,5 % of the notary act and 36% of the surface of the parcel (this parcel is part of the acquisition BERENS . Lines 20 &21, which is only partially financed by LIFE; as we approached the end of the project)

5.1.6.7 Outside LIFE

LIFE UNIO Project continued to buy 7,28 hectares outside the LIFE budget for the total of 344.344,12€, only in the catchment of the river Sauer. These were 15 land parcels bought with fundings by natur&ëmwelt and the MDDI.

These parcels are located in the direct vicinity of the Schwärzerbaach (Notary Number 701/2018, 445/2018 and 697/2018) and consist of farmlands which are now used extensively. Some parcels are deciduous forests in the NATURA 2000 area Upper Sure (Notary Number 697/2018 and 698/2018).

The total cost of this land is explained through the fact that the land is composed mostly of agricultural land, which has a higher price per are.

In parallel to the Land purchase BERENS; natur&ëmwelt was contacted by another landowner, wanting to sell 5 hectares of land parcels along the river Sauer representing 1 kilometre shore (Landpurchase table 22). Notary Number 698/2018 consist also two pastures in the flood plain, for which new leasing contracts are signed and fences are build.

These land purchases OUTSIDE LIFE could not be covered by the land purchase budget, but are nonetheless included in the landpurchase table. .

Table 3: Parcels bought outside LIFE funding

| Parcels | notarial act | Date of notarial act | Surface | community and section | field name | Total cost Outside LIFE |
|--------------|--------------|----------------------|---------------|---------------------------|----------------------|-------------------------|
| 776 | 701/2018 | 19.07.2018 | 8,20 | Rambrouch BA - BIGONVILLE | in Dermicht | € 1.535,22 |
| 2858/5866 | 698/2018 | 19.07.2018 | 5,00 | Rambrouch BA - BIGONVILLE | Bei der Oehlermuehle | € 108.445,20 |
| 4673 | 698/2018 | 19.07.2018 | 100,00 | Rambrouch BA - BIGONVILLE | in der Oicht | |
| 2880/1344 | 698/2018 | 19.07.2018 | 77,40 | Rambrouch BA - BIGONVILLE | Hockscheid | |
| 2857/5788 | 698/2018 | 19.07.2018 | 47,00 | Rambrouch BA - BIGONVILLE | Bei der Oehlermuehle | |
| 4671 | 698/2018 | 19.07.2018 | 218,50 | Rambrouch BA - BIGONVILLE | Mühlenfels | |
| 2857/5787 | 698/2018 | 19.07.2018 | 46,90 | Rambrouch BA - BIGONVILLE | Bei der Oehlermuehle | |
| 778/6286 | 445/2018 | 17.05.2018 | 105,50 | Rambrouch BA - BIGONVILLE | in Dermicht | € 34.800,00 |
| 700/6864 | 697/2018 | 19.07.2018 | 7,74 | Rambrouch BA - BIGONVILLE | in Dermicht | € 199.563,70 (*) |
| 700/6865 | 697/2018 | 19.07.2018 | 0,86 | Rambrouch BA - BIGONVILLE | in Dermicht | |
| 2452/7140 | 697/2018 | 19.07.2018 | 18,30 | Rambrouch BA - BIGONVILLE | Wiweschedeltchen | |
| 1886 | 697/2018 | 19.07.2018 | 28,80 | Rambrouch BA - BIGONVILLE | in Boidem | |
| 2107 | 697/2018 | 19.07.2018 | 16,40 | Rambrouch BA - BIGONVILLE | in der Rotschleid | |
| 2122/4182 | 697/2018 | 19.07.2018 | 27,00 | Rambrouch BA - BIGONVILLE | in der Rotschleid | |
| 2961/3 | 697/2018 | 19.07.2018 | 20,40 | Rambrouch BA - BIGONVILLE | in der Wohlbich | |
| Somme | | | 728,00 | | | € 344.344,12 |

(*) This sum covers also the part of Landpurchase Line 20 which could not be covered by the project's budget

5.1.6.8 Outlook

The purchase of land is the main objective of natur&ëmwelt, our mission is to buy land and manage it accordingly to protect nature and biodiversity. natur&ëmwelt HfN is provided with a yearly budget by the MDDI for the acquisition and management of land. The land acquired through LIFE UNIO will be managed accordingly after the project's duration (see the After-LIFE Conservation Plan for further details).



Figure 8: Plantation and deciduous forest near the source of the Schwaerzerbaach and well-structured pasture and wetlands near the source of Schwärzerbaach

5.1.7 ACTION C1: INTERVENTIONS POUR REDUIRE L'APPORT EN SEDIMENTS FINS DANS LE RESEAU HYDROGRAPHIQUE

5.1.7.1 Expected results

This action should lead to a reduction in sediment and nutrient input into both target rivers Our and Sauer. The action C1 plans the following:

- 2km of fence, 5 watering installations, 3 cattle bridges
- 60 water evacuation grids
- 40 agro-environmental measures
- 1 river bed restoration
- Pilot project Feierbëch

5.1.7.2 Activities and outputs

2.365 meters of streams in both catchment areas were fenced, 8 cattle watering installations and 4 cattle overpasses were built. These actions inhibit the cattle to directly water into the stream or to cross the stream, and thus help to reduce the input of nutrients and fine sediments. Seven agreements were signed with farmers to do these implementations. 63 water evacuation grids were installed on agricultural and forestry roads next to 5 different tributaries of Our and Sauer (in total 6.270 m).



Figure 9: Fencing, watering places and cattle passages built during the LIFE project



Figure 10: Water evacuation grids and restored riverbed

Table 4 gives an overview of the measures mentioned above.

Table 4: Overview over built fences, watering, cattle passages and water evacuation grids

| catchment | stream | site | fence (m) | watering | cattle passage | water evacuation grids |
|-------------|---------------------|-----------------------|--------------|----------|----------------|------------------------|
| Our | Roupelsbaach | | 370 | 1 | 2 | --- |
| Our | Heinerscheiderbaach | | --- | --- | --- | 19 |
| Our | Feierbëch | | --- | --- | --- | 18 |
| Our | Stroumbaach | Enkerich | 500 | 2 | 2 | --- |
| Our | Stroumbaach | Folkesbour | 250 | 1 | | --- |
| Our | Ruederbaach | | --- | --- | --- | 5 |
| Our | Bollertsbaach | | 35 | 1 | --- | --- |
| Our | Huschterbaach | | | | | 15 |
| Sauer | Syrbaach | River mouth / Gäsbech | 10 | 2 | --- | --- |
| Sauer | Sauer | Moulin d'Oeil | 450 | 1 | --- | --- |
| Sauer | Froumicht | Uewermant | 250 | --- | --- | --- |
| Sauer | Froumicht | Waschburen | 100 | --- | --- | --- |
| Sauer | Schwärzerbaach | Rammericherwee | --- | --- | --- | 6 |
| Sauer | Schwärzerbaach | Dermicht | 400 | --- | --- | --- |
| Objectives | | | 2000m | 5 | 3 | 60 |
| Done | | | 2365m | 8 | 4 | 63 |

Furthermore, 20 agro-environmental (47,20 ha, 12 432-RN programs and 8 482-P2 programs) measures and 62 biodiversity contracts (107,21 ha, 56,37 ha river Our catchment & 50,84 ha river Sauer catchment) were made with farmers covering 154,41 hectares of land, an action to incite farmers to labour in a more extensive way. For further details concerning agro-environmental measures and biodiversity contracts, please consider the annex 18, annex 19 and annex 20.

Since the restoring of the river bed of the stream Heinerscheiderbaach was not possible (see 5.1.7.6), we decided to restore parts of the river beds where migration obstacles were removed and where bridges were installed. Table 5 below gives an overview of the river bed restoration measures. In total, parts of the river beds of 5 streams were restored covering a distance of 520 meters (see annex 18)

Table 5: Riverbed restoration

| catchment | tributary | length [m] | done [year] |
|--------------|---------------------|--------------|-------------|
| Sauer | Schwärzerbaach | 100 | 2016 |
| Sauer | Froumicht | 120 | 2018 |
| Our | Ruederbaach | 90 | 2017 |
| Our | Feierbech | 100 | 2015 |
| Our | Huschterbaach | 110 | 2018 |
| Our | Heinerscheiderbaach | Not possible | --- |
| Total | | 520 | |

To further support the outcome of this action C1, the LIFE Unio team started a pilot project in the catchment of the stream Feierbëch. The aim of this pilot project was to show the farmers in this area the evolution of nitrogen on their plots, with the idea that they will adapt and optimize their fertilization in the future. We took soil and water samples to see correlation between the nitrogen concentration in the soil, in the water and the during the year (see 5.1.7.5).

In conclusion, it is not possible to calculate a rough estimation of the fine sediment expressed as percentage. The quantity of sediment is depending on the season, the weather and the management on the agricultural land. We can observe a good vegetation and stabilisation of the riverbanks because of fencing. Forest roads need less maintenance because of the water evacuation grids. The agri-environmental measures helps farmers to practice more sustainable. We can see a qualitative improvement but we are not able to quantify these results.

5.1.7.3 Time schedule

| C1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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5.1.7.4 Indicators

Before and after installing the measures we monitored the water quality, we installed sediment traps and measured the interstitial redox potential – see D4.

5.1.7.5 Technical and / or financial modifications and justifications

The implementation of the 40 AEM was a problem at the beginning of the project. The proposal of the national agriculture plan "Plan du développement rural 2014-2020" was under evaluation in Brussels and was not approved until 2017. Therefore, it was not possible to sign any contracts before 2017. Meanwhile waiting for the PDR to be approved, we also started to negotiate biodiversity contracts with the farmers. This in cooperation with the Nature Park Our, the Nature Park Uewersauer and the ANF (see also supporting letter in annex 20) covering an area of about 107 hectares of land (further details are provided in the annex 18 and annex 19).

Until the new AEM were officially accepted by the end of 2017 we were working on a pilot project in the catchment of the stream Feierbëch, an area covering around 0,5 km² with agricultural activity in the catchment of the river Our. The goal was a better understanding of the results of our water survey as the farmers were willing to give us a detailed list of the amount of fertiliser applied on their fields. With the help of the counsellors of the national agriculture chamber and IBLA, a Luxemburgish institute promoting organic farming, we wanted to reduce the nitrate input into the Feierbëch. The target was the best possible land management with the current programmes.

In order to monitor the agricultural practices of 10 farmers in the catchment of the Feierbëch, soil samples were taken three times a year. Those samples were checked on nitrogen residues to get an idea about the amount of fertiliser, which was used, on those plots. The results were shown to the farmers, cultivating in this catchment, during information events (see action E1 for further details on these events). The aim of this pilot project was to show the farmers the amount of residues, not only in the soil, but also the evidence of higher amounts of nitrogen in the waters of the Feierbëch. The visualization of these results will most probably have an effect on the future practises of those farmers, since one part of the fertiliser they bring on their plots will not be up taken by their crops and will be lost and washed away through the waters of the Feierbëch and the river Our (see annex 21).

The action of the riverbed restoration had to be changed, because it was not possible to restore the streambed of the river Heinerscheiderbaach. Therefore, the LIFE Unio team decided to restore parts of the riverbed of the streams Feierbëch, Ruederbaach and Huschterbaach in the catchment of the river Our and the streams Schwärzerbaach and Froumicht in the catchment of the river Sauer.

5.1.7.6 Problems encountered

The restoration of the riverbed in the stream Heinerscheiderbaach was classified as not possible by the forestry administration (ANF). The reason are:

- ⇒ Income of surface water of the village Heinerscheid – less buffer capacity
- ⇒ Temporary high amounts of water – increasing because of soil sealing
- ⇒ Already destroyed length about 500 m and 3 m depth – high costs to refill this volume with soil and stones
- ⇒ Buying of land is necessary
- ⇒ Work as to be done with specialists to avoid new destruction – high costs

For more details, see the letter in annex 22. Therefore, we restored parts of the riverbeds of the streams mentioned above.

See also the comments in the letter 07/11/2016 from EC.

5.1.7.7 Outside LIFE

The restoration of the riverbed Feierbëch was financed outside LIFE by the national administration responsible for road construction (Administration des Ponts et Chaussées). The road next to the Feierbëch was modernized. This gave the opportunity to restore parts of the riverbed Feierbëch.

In addition to the riverbed, 500 meters along the stream Träsbëch were fenced out in cooperation with the Natur Park Our. This action was also financed by the community Parc Housen.

5.1.7.8 Outlook

Concerning the fences, watering places and cattle bridges, which were built, a convention (see annex 23) has been signed with the farmers using the lots, which force them to maintain the fence, the watering installations and the cattle passages over a period of 10 years.

Agro-environmental measure and biodiversity contracts cover a period of 5 years. After those 5 years, the beneficiary will do its best to extend the contracts, so that extensive farming practises can proceed.

Concerning the 63 water evacuation grids, which were installed, the local foresters promised us to maintain and clean the grids from leaves and soil. Only by keeping the grids clean, the positive effect of those grids can be guaranteed.

As the work for the riverbed restoration on Feierbëch, Ruederbaach, Hüscherbaach, Schwärzerbaach and Froumicht has been completed, we will monitor the situation regularly to see if the riverbeds are stable. In case of any problems, we are going to contact the ANF and AGE to help to fix the problems.

To incite the farmers on adapting their fertilization practices in the future, the pilot project Feierbëch will also continue in the After LIFE. More information events are planned in the near future (see the After-LIFE Conservation Plan on this).

5.1.8 ACTION C2: TRANSFORMATION D'OBSTACLES A LA MIGRATION DES POISSONS SUR LES COURS D'EAU TRIBUTAIRES

5.1.8.1 Expected results

The intention of this action is to remove or transform 6 migration obstacles for fish in order to make them passable again (3 at the river Our and 3 at the river Sauer)

5.1.8.2 Activities and outputs

In the "Restoration measure plan" which was sent to the EC, 57 obstacles were mentioned with different priorities. We selected 10 potential obstacles, which could be removed.

In the year 2014, several meetings and site visits were organised with employees of the AGE. The removal of fish obstacles started in June 2015 and was finished in November 2018 (see Table 6 below). All work was financed by LIFE except Feierbëch (details and pictures can be found in annex 24, the authorisations in annex 25).

Table 6 : Obstacle transformation

| catchment area | tributary | obstacle | reopened | riverbed restoration | finished |
|--------------------|--------------------|----------|----------|----------------------|---------------|
| Sauer | Syrbaach | ford | 2.400 m | no | June 2015 |
| Sauer | Schwärzerbaach I | tube | 700 m | yes | October 2015 |
| Sauer | Schwärzerbaach II | tube | 700 m | no | October 2015 |
| Sauer | Schwärzerbaach III | tube | 500 m | no | October 2016 |
| Our | Ruederbaach | tube | 1.000 m | yes | February 2017 |
| Our | Huschterbaach | tube | 1.800 m | yes | November 2018 |
| Sauer | Froumicht | tube | 1.500 m | yes | November 2018 |
| Our – outside LIFE | Feierbëch | tube | 1.000 m | yes | December 2016 |

In total 9.600 m stream length were reopened and accessible for fish and aquatic fauna.



Figure 11: Syrbaach – ford and Schwärzerbaach



Figure 12: Schwärzerbaach – 2 bridges



Figure 13: Ruederbaach and Huchterbaach



Figure 14: Froumicht and Feierbëch (Outside LIFE)

Wastewater from the village Bigonville still discharges into the stream Froumicht. In 2017 the local community together with the local waste water treatment organization started to install new pumps and tubes to deviate the waste water to a treatment plant. This work should be finished in 2019. The Froumicht should become much cleaner and its ecological quality should improve afterwards.

5.1.8.3 Time schedule

| C2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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5.1.8.4 Indicators

Before and after removing the tubes we did electric fishing – see actions D3 and D4.

The removal of the fish obstacles showed, that normally after one year the fish appeared again in the upstream sections. As these section were before the transformations not populated by fish, all these measures were a success. Overall 9,6 km were reopened and reconnected to the main streams. It is not possible to show the quantitative impact of the reopening of the tributaries on the reproduction of Unio crassus directly. As Unio crassus is only present in the main streams and uses many fish species for reproduction this is difficult to analyse.

5.1.8.5 Technical and / or financial modifications and justifications

We removed in total 7 obstacles financed with LIFE and one obstacle financed Outside LIFE.

AGE did the planning of the removal and therefore we used the money for the planning (A2) for the construction of the bridges.

5.1.8.6 Problems encountered

No Problem encountered.

5.1.8.7 Outside LIFE

In March 2015, we were informed that the street next to the Kalbermillen should be reconstructed.

After the riverbed restoration (see action C1) the remaining tube was removed by the AGE (December 2016). The budget used outside LIFE was € 47.993,23.

5.1.8.8 Outlook

In the After LIFE Action Conservation Plan no removing of fish obstacle is foreseen. But there are still fish obstacles in the project area which should be removed. The action can only be continued with the help of AGE and the Fond de l'eau.

We already started a new project to remove the fish obstacle at Gemünder Akeschterbaach together with ANF and AGE – the next meeting will be in May 2019.

5.1.9 ACTION C3: AMELIORATION DU SUBSTRAT PAR DEPOT DE GRAVIER

5.1.9.1 Expected results

The intention of this action is to improve the quantity and quality of the river substratum in both rivers by the creation of clean gravel depots at five sites in each river. 100 m³ of gravel will be put in each river every year.

5.1.9.2 Activities and outputs

During this action, 4 sites (“Laangewuess”, “Hieourwiese”, “Kalborn Mill”, “Groußenauel”) along the river Our and 4 sites (2 sites close to “Ferme d’Oeil”, “Esperbech”, “Ale Kessel”) along the river Sauer were selected for gravel input (for details concerning the dumping sites, please see annex 26). A total of 1.038 m³ was dumped into the rivers Our and Sauer (see Table 7) over a period of 6 years. More than 2.600 m² of new gravel banks could be restored in both rivers combined. The fraction size of the gravel ranged between 16 and 32 mm and came from a local quarry. We chose the substratum to be from the Ardennes region with the same geological type of rock.

For both rivers, we asked a permission for dumping the gravel – Luxembourg, Germany and Belgium. All permission can be found in annex 27.



Figure 15: Gravel input and new created gravel banks

We carefully chose the right weather conditions for the gravel dumping action. Frozen soil made it easier to execute the work without entailing too much damages to meadows and the river banks itself.

Table 7 shows the amount of gravel we put into both rivers.

Table 7: Input of gravel during the project period

| amount gravel (m ³) | 2012, 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---------------------------------|------------|--------|--------|--------|--------|--------------|-----------------|
| Our | 203,29 | 127,94 | 118,59 | 108,78 | closed | closed | 558,60 |
| Sauer | 0,00 | 95,98 | 76,10 | 116,33 | 200,00 | closed | 479,91 |
| | | | | | | total | 1.038,51 |

5.1.9.3 Time schedule

| C3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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O= only river Our

S= only river Sauer

5.1.9.4 Indicators

To quantify the outcome of this action, we mapped the new created gravel banks between July and September 2017. A detailed mapping of each dumping site can be found in the annex 26. Combining the four gravel input sites in the catchment of the river Our, we were able to map 1.855 square metres of new created gravel banks. On the river Sauer, we could map 790 square metres of new gravel banks, which makes a total of 2.645 square metres for both rivers combined.

To evaluate this action, we measured the interstitial redox potential. We could also observe a very high density of minnows spawning on these new created gravel banks. The European Minnow is the most abundant fish species in both river systems and the best host fish for *Unio crassus* in our area. Therefore, the newly created gravel banks have a positive impact on the thick shelled river mussel population. For further details, see action D4.

Table 8 and Table 9 show an overview of the gravel banks created at each site in both catchments.

Table 8: Gravel banks created on the river Our

| | deposit site | dispersion length (meters) | surface (square meters) |
|--------------|-----------------|----------------------------|----------------------------|
| 1 | Feischbur | 46 m | 1 64 m ² |
| 2 | Hiourwiese | 150 m | 1.000m ² |
| 3 | Mill of Kalborn | 110 m | 381 m ² |
| 4 | Auf großen Auel | 55 m | 310 m ² |
| Total | | 361 m | 1.855 m² |

Table 9: Gravel banks created on the river Sauer

| | deposit site | dispersion length (meters) | surface (square meters) |
|--------------|--------------|----------------------------|--------------------------|
| 1 | Ferme d'Oeil | - | - |
| 2 | Ferme d'Oeil | 150 m | 520m ² |
| 3 | Esperbësch | 120 m | 250 m ² |
| 4 | Ale Kessel | 16 m | 20 m ² |
| Total | | 286 m | 790 m² |

5.1.9.5 Technical and / or financial modifications and justifications

In the catchment of the river Our, we selected 4 sites instead of 5 to dump the gravel into the river. We excluded the site "Schankbaach" in direct neighbourhood of the Kalborn Mill because the dump tractor had to pass a meadow. As we wanted to avoid paying compensations to the landowner, we decided not to dump any gravel in the river from here.

At the start of the project in 2012, we did not put any gravel in any of the two rivers. Therefore, we put 200m³ of gravel into the river Our in 2013 to compensate the year 2012.

We were not able to put any gravel into the river Sauer in 2013, since we had not yet the authorisation from the Belgian authorities. The letters to obtain the permission were sent to the authorities in Luxembourg and Belgium in January 2013. Authorisation from Luxemburg authorities was available on the 12.06.2013 and a refusal from Belgium on the 07.03.2013.

The refusal was based on an "arrêté royal" from 1970 that interdicts the input of external material into the river in order to avoid flooding. It took us more than a year to get this demand revised and approved on the 23.06.2014. In our new demand we excluded the inhabited sites near a village and a mill and we proposed 5 alternative sites. Finally we had to drop one more place because of its bad accessibility. The authorisation from the Belgium authorities was obtained in June 2014 (see also annex 16 submitted with the mid-term report in March 2015). Therefore, between 2014 and 2018 we were able to dump the foreseen amount of gravel in the Sauer at the respective sites.

Due to problems that most of the gravel remained at the shore at site 1 "Ferme d'Oeil" in the catchment of the river Sauer in 2015, we decided to abandon this site. Therefore, in 2016, we only used two sites to put new gravel into the river Sauer. In 2017, we selected another site close to "Ferme d'Oeil" for dumping instead of the first dumping point at "Ferme d'Oeil".

To conclude, the dumping of gravel into the river Our was already finished one year earlier in 2016. As we started a year later on the river Sauer, we also finished one year later. As no dumping was possible in 2017 at the Sauer, because the weather conditions did not allow it, this action was closed at the beginning of 2018.

5.1.9.6 Problems encountered

Apart from dumping difficulties at site 1 “Ferme d’Oeil” and the delay of the dumping in 2013 and 2017 (because of the weather conditions) in the catchment of the river Sauer, no major problems occurred for this action.

5.1.9.7 Outside LIFE

No action has been done outside LIFE.

5.1.9.8 Outlook

Since we observed many fish using the new created gravel banks as spawning grounds, we will try to find a financial support to continue with this action in the future. The action could probably be financed by the fond de l’eau in cooperation with the COPIL Eislek.

5.1.10 ACTION C4: ELEVAGE DE *UNIO CRASSUS* POUR LA GRANDE REGION**5.1.10.1 Expected results**

The action deals with all the necessary steps to culture juvenile *Unio crassus* at the rearing facility at the mill of Kalborn.

5.1.10.2 Activities and outputs

The rearing of the thick-shelled river mussels involves different steps, from collecting larvae and host fish, to collecting juvenile mussels. The following tables give an overview about the different steps and the work done in the respective years.

- **Collect adult mussels in both streams of concern (Our & Sauer)**

Table 10: Date and number of transferred adult mussels from both river to the rearing facility

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---------------------------------------|---------------|--------|--------|---------------|--------|---------------|
| Date/period - Our taken | 2012 | 04.04. | 22.04. | 08.04. | 05.04. | 06.04-10.04. |
| Date - Our return of parent mussels | 18.07. | 24.06. | 18.07. | 10.08. | 25.08. | 05.04.2019 |
| Number - Our taken | 100 | 50 | 63 | 81 | 141 | 84 |
| Number - Our return | 95 | 47 | 47 | 70 | 135 | 82 |
| Date/period-Sauer taken | 22.04.-29.04. | 21.03. | 24.04. | 12.04.-02.05. | 07.04. | 09.04.-18.04. |
| Date - Sauer return of parent mussels | 11.07. | 02.07. | 15.07. | 10.08. | 09.08. | 11.07. |
| Number - Sauer taken | 50 | 65 | 36 | 60 | 120 | 67 |
| Number - Sauer return | 55 | 59 | 34 | 48 | 109 | 55 |

For both rivers, it was always possible to collect enough adult mussels. For the river Our, in total 519 mussels were collected in the 6 years, from which 476 could be returned. There was a loss of 8% of the mussels at the mill. In the river Sauer in total 398 animals were collected and 360 could be returned. The survival rate of the adult mussels from the river Sauer was 90,5%. All mussels were normally collected in April.

- **Collect the host fish minnow (*Phoxinus phoxinus*) from the river**

Table 11: Collection of host fish

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------|--------|--------------|---------------|---------------|---------------|--------------|
| date/ period | 07.05. | 18.03-16.05. | 10.04.-07.05. | 14.03.-04.05. | 15.03.-26.04. | 05.04.-11.05 |
| number | 523 | 585 | 1199 | 1.363 | 1.740 | 2.955 |

The collection of the host fish was always done by electric fishing and except for the year 2018, where also 1375 fish were caught in the river Sauer, all fish were collected in the river Our. The host fish were caught between late March and early May with the focus in April. To collect enough juvenile mussels it was necessary to catch more than the initially 200 foreseen minnows. This was however causing no problems, as the minnow is one of the most abundant fish species in both rivers (see also D2).

- **Infestation of the host fish**

Table 12: Number and period of host fish infestation

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Period Our | 11.05-29.05. | 01.05.-18.05. | 27.04.-20.05. | 28.04.-20.06. | 02.05.-06.06. | 25.04.-28.05. |
| Number Our | 583 | 345 | 649 | 915 | 705 | 1.086 |
| Period Sauer | 12.05.-23.05. | 23.04.-28.05. | 28.04.-26.06. | 08.05.-22.06. | 05.05.-02.06. | 24.04.-30.05. |
| Number Sauer | 300 | 314 | 803 | 1.114 | 892 | 1.491 |
| Total | 883 | 659 | 1.452 | 2.029 | 1.597 | 2.577 |

The main period of the fish infestation was always in May. At the beginning of the project, we noticed that the initially foreseen 200 minnows would not be enough to collect > 2.500 juvenile mussels. On average the minnow carried +/- 10,5 glochidia/fish. Except for the first two years, we were always able to infest >500 fish per river. The difference between the number of infested fish in Table 12 and the number of minnow caught in Table 11 is due to the fact, that between 2013 and 2016 also other fish species than minnow were infested. We also tried brown trout, bullhead, three spined stickleback and chub. The brown trout strain we used was not a suitable host fish. Bullhead, stickleback and chub turned out to be also a host fish, but their handling during the collection process was more difficult. Therefore the minnow turned out to be the most suitable host fish for the culture of *Unio crassus*.

- Collection of juvenile mussels

Table 13: Period and number of juvenile mussels collected

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Period Our | 25.06-17.07. | 03.06.-27.06. | 03.06-05.07. | 01.06.-01.07. | 06.06.-30.06. | 04.06.-09.07. |
| Number Our | 1.391 | 2.329 | 7.007 | 15.308 | 9.230 | 14.093 |
| Period Sauer | 24.06.-22.07. | 03.06-27.06. | 01.06.-07.07. | 30.05.-11.07. | 06.06.-30.06. | 04.06.-09.07. |
| Number Sauer | 1.200 | 1.905 | 16.122 | 47.798 | 12.726 | 22.663 |
| Total | 2.591 | 4.234 | 23.129 | 63.106 | 21.956 | 36.756 |

Except for 2013, the first viable mussels always encysted from the host fish at the beginning of June. The collection period always lasted for +/- 4-6 weeks. Except for the first two years, we were always able to collect > 5.000 juvenile mussels per year.

- Growth of juvenile mussels.

After the collection, the juvenile mussels were transferred into different rearing systems. The rearing protocol available as a download at <https://www.unio.lu/files/72719.pdf> (see also annex11) describes the different methods used (see also A4). Figure 16 shows the procedure that turned out to work best at the mill of Kalborn so far.

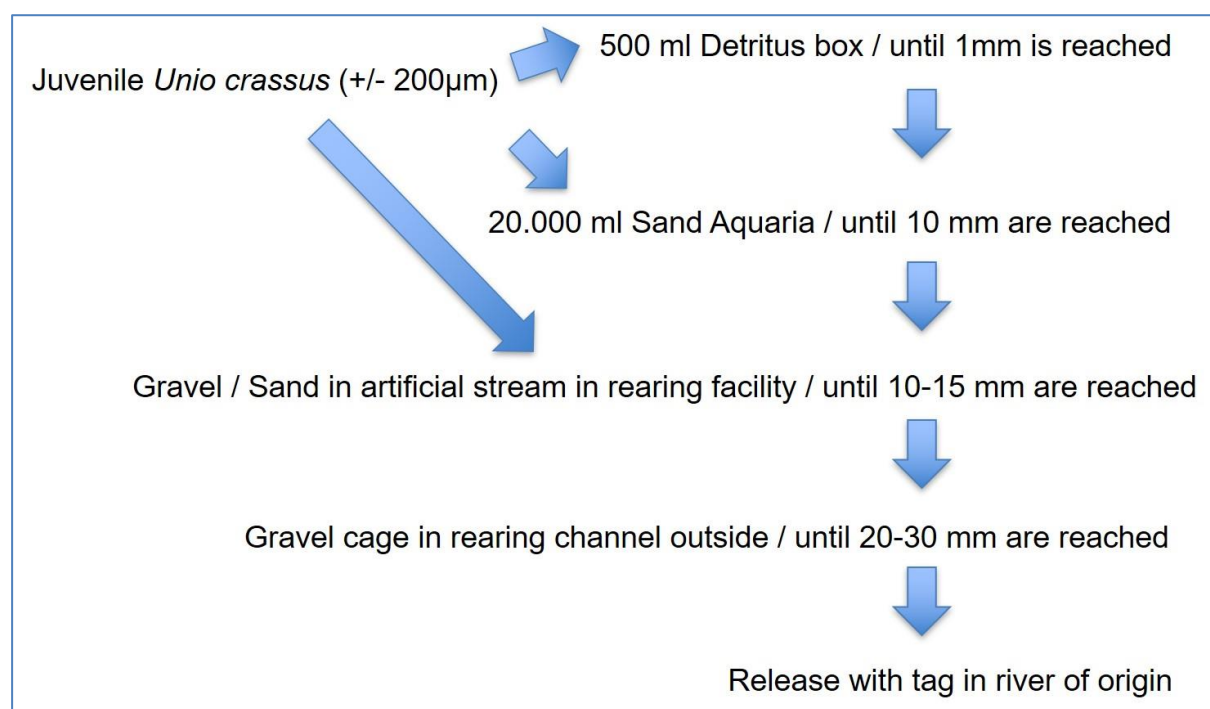


Figure 16: Summary of the rearing protocol

- **Fish cages in the river.**

Table 14: Fish cages in the river

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------------------|---------------------|-------------------------|--------------|---------|---------|---------|
| Our Date out | 18.06. | June | 12.06. | 10.06. | 29.05. | 11.06. |
| Our Number out | 101 | 0 | 300 | 154 | 100 | 120 |
| remark | in cage | impossible due to flood | without cage | in cage | in cage | in cage |
| Sauer Date out | 27.06. | June | 22.06-29.06. | 15.06. | 02.06. | 15.06. |
| Sauer Number out | 170 | 0 | 1.015 | 100 | 100 | 120 |
| remark | trouts without cage | impossible due to flood | without cage | in cage | in cage | in cage |

Due to a high water level, it was impossible to install a cage in 2014 and 2015. Therefore, in 2015 we decided to release at least an elevated number of infested fish without a cage. In the last three years (2016, 2017 and 2018) we were always able to install a cage in both rivers.

- **Release of cultured mussels**

In the fourth year (2016) 500-1.000 mussels should be released in both streams. Therefore, until 2019 +/- 2.000 mussels should at least be released in each river. Due to often-unfavourable water levels, we waited with the release until summer 2018. The postponement of this release also allowed the project team to tag the mussels as they reached the minimum size for this. For the river Our so far 808 mussels have been released and for the river Sauer 1.078 (see annex 28, IMPORTANT, annex 28 is only for internal use as it contains sensible information about the localisation of sensible animals, please keep it confidential). Another +/- 1.000 mussels from each river will be released in 2019 (882 river Our and 1.237 river Sauer). Therefore the project finally reached the 2.000 mussels objective for the river Sauer (overall 2.315 in summer 2019) but for the river Our we are with 1690 individuals in summer 2019 slightly below the expected target.

Table 15: Fish cages in the river

| Site | Date | Tag - Numbers | Number released |
|--------------|------------|---------------|-----------------|
| Hiour | 29.06.2018 | 2001-2346 | 349 |
| Groussenaue | 02.07.2018 | 2347-2565 | 219 |
| Stolzembourg | 20.07.2018 | 2566-2800 | 240 |
| Total: | | | 808 |

Table 16: Release of mussels in the river Sauer

| Site | Date | Tag - Numbers | Number released |
|------------------|------------|------------------------|-----------------|
| Moulin d'Oeil I | 30.05.2018 | 2041-2280 | 577 |
| Moulin d'Oeil II | 11.07.2018 | 2281-2421 1001-1354 | 501 |
| Total: | | | 1.078 |

5.1.10.3 Time schedule

| C4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | planned |
| | realized |

5.1.10.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|--------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment rearing facility with the necessary material | 28.02.2013 | By the end of February 2013 we had all the necessary equipment to start the first rearing cycle. Most of the other equipment was purchased within the first half of the project. |

5.1.10.5 Technical and / or financial modifications and justifications

The EC granted the release of fishes outside cages (letter ENV-E-3 SG/LM/ip 26.05.2016). No other technical or financial modifications were necessary in this action.

5.1.10.6 Problems encountered

The problems to install the cages with infested fish in 2014 and 2015 due to high water levels could not be foreseen. The cages need to be installed in June, as later the mussels will be lost from the fish. Therefore, in 2015 a higher number of infested fish was released without a cage (Granted by the EC in its letter ENV-E-3 SG/LM/ip from 26/05/2016). We were slightly under the target to release at least 2.000 mussels for the river Our until 2019. As the culture improved over the years and the rearing will continue in the after LIFE programme we can catch up with this number in the following year.

5.1.10.7 Outside LIFE

Almost every year we took care of a few juvenile *Unio crassus* mussels from a similar project from Switzerland.

5.1.10.8 Outlook

In the project runtime around 2.000 mussel for each river could be produced and released (2.000 released in 2018 and 2.000 waiting to be released in 2019). Taking into account the estimated population numbers in both rivers (15.000 Our & 14.000 Sauer) this augmented the populations in both rivers by 13-14% respectively. In addition, the ecosystem services directly provided by the released *Unio crassus* are not negligible. The release of 2.000 mussels per river will provide a filtration capacity of around 36 million litre per river per year. A positive observation was that in both rivers minnows, which were naturally infested by *U. crassus*, were present. Between 1990 and now, the river Our population increased from estimated 6.000 animals to estimated 15.000 animals. The tagged mussels from the project runtime and the tagged (cultured) released mussels need to be followed in after LIFE period (2019 -2024) to get an overview about their survival and mortality over time. We judge it important to continue the release of cultured mussels (+/- 500-1.000 mussels /year) in the river Our for the following 5 years. The evaluation of the population by 2024 will guide us in the decision if the river Our population has become self – sustainable by that time.

The rate of empty shells found during monitoring in the river Sûre was much higher than for the river Our and this population showed in contrast to the river Our a decrease in numbers between 2003 and 2018. On the other hand, wild minnows were very well infested in this river during our surveys. It might be, that we underestimated this population and we need, as for the river Our, to follow the survival and mortality over time. We also judge it for this river important to continue the culture and to add 500-1.000 animals per year until 2024. The evaluation of the population by 2024 will help us to decide if stocking is still necessary.

The rearing will continue at least for the next 5 years (see After LIFE), as it is an important part of the after LIFE programme.

5.1.11 ACTION C5: REGULATION DE LA PREDATION DU RAT MUSQUE

5.1.11.1 Expected results

The muskrat are captured to reduce and/or to maintain the populations at a low level in the both rivers.

5.1.11.2 Activities and outputs

Although in the initial project proposal, the muskrat trapping was only foreseen to be done twice per year, the trapping took place year-round if the water level of the river allowed access. Table 17 shows the number of muskrat caught in the respective sections of the river Our and in the river Sauer in the respective year. Upper Our represents the stretch from the three border triangle to Stolzembourg and lower Our is the section from the city of Vianden to Wallendorf-Pont. The lower Our section was not part of the LIFE Unio project area, but is listed here to be accurate.

The ANF is developing action plans for most invasive species and is supporting this action in future.

Table 17: Number of Muskrat caught in the rivers Our and Sauer in the respective year

| period | 04.09 - 30.10.2012 | 08.01 - 19.12.2013 | 04.03 - 26.11.2014 | 24.02 - 11.12.2015 | 10.03 - 16.12.2016 | 04.04 - 31.10.2017 | 21.03 - 31.10.2018 |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Upper Our | 5 | 34 | 46 | 68 | 41 | 12 | 25 |
| Lower Our | 3 | 16 | 23 | 36 | 17 | 7 | 9 |
| Sauer | 3 | 19 | 21 | 39 | 27 | 12 | 20 |
| Total | 11 | 69 | 90 | 143 | 85 | 31 | 54 |

The trapping helped to keep the muskrat population at a low level and in both rivers and no obvious by the muskrat caused shell midden, could be observed. The table also shows that the number of muskrat fluctuates from year to year and that after a year with only a few animals caught (2017) the following year the numbers can again be much higher. To keep the number of the animals at a low level a continuous trapping is required.

5.1.11.3 Time schedule

| C5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | planned |
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5.1.11.4 Indicators

No new mussel shell midden caused by the muskrat could be observed during the project time.

5.1.11.5 Technical and / or financial modifications and justifications

From the year 2015 on, we also started to regulate the population of the signal crayfish (*Pacifastacus leniusculus*) (authorisation can be found in annex 29). From the beginning of the project, a low presence of the Signal crayfish in the river Sauer was known. A monitoring of the river Our between the year 2011-2012 showed no presence. However, from 2013 on we heard about first observations of signal crayfish in the area of Tintsmillen.

Therefore we initiated in 2014 a master thesis together with the student Elisabeth Kirsch from the University of Leeds UK, to investigate the Predatory impact of the non-native signal crayfish on the endangered thick shelled river mussel (*Unio crassus*). As the population at Tintsmillen showed a massive increase between 2013 and 2015 and as the master thesis from Elisabeth Kirsch showed that the Signal crayfish has an impact on the shell of *Unio crassus*, we decided to establish also a trapping for this invasive species on both rivers. Table 11 shows the number of Signal crayfish caught in both rivers since 2015

Table 18: Numbers of crayfish caught since 2015

| | | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------|-------------|--------|------|------|--------------|--------------|---------------|--------------|
| Period | | | | | 10.07-26.10. | 12.07-15.12. | 17.05-15.10. | 07.05-16.11. |
| Our | Hand | 0 | 0 | 0 | 866 | 2.738 | 120 | 216 |
| | Fyke | 0 | 0 | 0 | 154 | 1.279 | 1.051 | 5.166 |
| | Total Our | 0 | 0 | 0 | 1.020 | 4.017 | 1.171 | 5.382 |
| Period | | | | | | | 17.05.-15.10. | 23.03-08.11. |
| Sauer | Hand | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fyke | 0 | 0 | 0 | 0 | 0 | 230 | 1.913 |
| | Total Sauer | 0 | 0 | 0 | 0 | 0 | 230 | 1.913 |
| | Total | 0 | 0 | 0 | 1.020 | 4.017 | 1.401 | 7.295 |
| | Sum | 13.733 | | | | | | |

5.1.11.6 Problems encountered

Another invasive species, the signal crayfish (*Pacifastacus leniusculus*), also showed to have an impact on the population of *Unio crassus*. A trapping of this species was established. See point 5.1.11.5 of this section.

5.1.11.7 Outside LIFE

The master work from the student Elisabeth Kirsch (University of Leeds, Faculty of Biological Sciences) investigated the Predatory impact of the non-native signal crayfish (*Pacifastacus leniusculus*) on the endangered thick shelled river mussel (*Unio crassus*) (see annex 30). This work was not foreseen from the beginning of the project, but helped to understand the impact of non-native crayfish on endangered freshwater mussel populations.

All muskrat caught are frozen and given from time to time to the work group of Dr. rer. nat. Thomas Romig from the university of Stuttgart Hohenheim. The muskrat are used for parasitological research. A first outcome of this outside LIFE collaboration was the Bachelor thesis of Sebastian Nicodemus entitled

“*Echinococcus multilocularis* und andere Cestodenlarven in Bisamen (*Ondrats zibethicus*) aus Luxemburg” (submitted as annex 19 with the mid-term report in March 2015).

5.1.11.8 Outlook

The trapping of both species is also foreseen in the After LIFE Resto Unio Action plan (see annex 50 in action F3) and will at least continue from 2019 to 2023. The appearance of new top predators (e.g. Otter, Wolf) might help to regulate the population in a more natural way in the future. However so far, these species have not returned to northern Luxembourg.



Figure 17: Signal crayfish caught in the river Our

5.1.12 ACTION D1: SURVEILLANCE DE LA QUALITÉ DE L'EAU ET DU SUBSTRAT INTERSTITIAL

5.1.12.1 Expected results

The quality of the water and the interstitial sediment have to be monitored and the results should be presented at the water forums to national and international stakeholders.

5.1.12.2 Activities and outputs

Once a week samples from each target river were taken and analysed. The parameters such as temperature, pH value, conductivity, turbidity, oxygen concentration, ortho-phosphate, nitrite, ammonium, chloride and nitrate were determined. Three times a year we took samples from all springs and tributaries of both the river Our and Sauer. In cooperation with the AGE we took once a year sample of 10 to 12 springs to investigate the pesticide and metal concentration. Besides, we took samples where we implemented concrete measures as well as at points of interests (new springs, water of unknown tubes etc.).

The online monitoring system on the river Our worked with minor problems.

The mobile online monitoring system in the river Sauer catchment is working since August 2014 at the river Syrbaach. The mobile turbidity logger was used at different places to monitor the water quality.

Water quality and turbidity

In February 2013, we started to take regular samples. We took 3.224 water samples of rivers, streams and points of interests. Additionally, we monitored the water we use in the rearing facility. In total, we analysed 3.752 samples. 751 samples from the river Our and Sauer, 556 samples from tributaries, 1.102 samples from springs and 174 samples from points of interests (new springs, water of unknown tubes etc.). Overall, about 641 samples were analysed from points where restoration measures took place.

In case of any pollution, we observed during water or mussels monitoring, we informed the AGE accordingly. We did this in the years 2015, 2016 and 2018 especially for the stream Scheelsbach and the biogas plant in Hosingen. Further investigation was done by the AGE to find the reason of the pollution.

In the year 2016 we charged the Luxembourg Institute for Science and Technology (LIST) to measure the pesticide concentration at selected places in the river Our and Sauer. The report can be found in annex 31.

The annex 32 and annex 33 give an overview about the water quality in the year 2018 respectively during the period 2013 -2018. Both reports present graphs of the measurements of the rivers, their tributaries and other data dealing with the water quality. The ions nitrate, chloride and nitrite are discussed in these annexes as well.

In Table 19 an overview of the mean over the 6 years project time is shown. There is a big difference between the river Our and Sauer relating to discharge and turbidity.

Table 19: Mean of several water parameters from the river Our and Sauer 2013-2018

| Parameter | Our (Kalbermillen) | | | Sauer/ Moulin de Bigonville | | |
|-------------------------------|--------------------|---------------------|---------|-----------------------------|---------------------|---------|
| | Annual mean | | | Annual mean | | |
| | value | water quality class | | value | water quality class | |
| | | Luxembourg | Germany | | Luxembourg | Germany |
| Discharge [m³/s] | 5,5 (Ouren) | --- | --- | 4,1 (Bigonville) | --- | --- |
| Water temperature [°C] | 9,9 | --- | --- | 10,2 | --- | --- |
| Conductivity [µS/cm] | 150,9 | --- | --- | 159,0 | --- | --- |
| Turbidity [FNU] | 6,4 | --- | --- | 9,2 | --- | --- |
| Nitrate [mg/L] | 15,9 | good | II -III | 15,5 | good | II -III |
| nitrite [mg/L] | 0,05 | very good | I | 0,05 | very good | I |
| ammonium [mg/L] | 0,06 | very good | I-II | 0,08 | very good | I-II |
| chloride [mg/L] | 16,8 | --- | I | 18,9 | --- | I |

Sources:

Luxembourg:

https://eau.public.lu/actualites/2009/12/plan_de_gestion/Methodenhandbuch.pdf

Germany

https://www.umweltbundesamt.de/sites/default/files/medien/1968/dokumente/chemische_guteklassifikation.pdf

The mean parameters for the different parameters shown in Table 19 above are still in a range, which supports *Unio crassus* populations. Recent acute toxicity test showed that *Unio crassus* can support much higher Nitrate levels as expected (Karel Douda (2010). Effects of nitrate nitrogen pollution on Central European unionid bivalves revealed by distributional data and acute toxicity testing. Aquatic Conservation Marine and Freshwater Ecosystems 20(2):189 – 197). Also the study from Deniv M., Stoekl K., Gum B. & Geist J. (2013) Physicochemical assessment of *Unio crassus* habitat quality in a small upland stream and implications for conservation. Hydrobiologia DOI 10.1007/s10750-013-1467-z showed that Uc population can tolerate much higher levels of Nitrate and sediment deposition than for instance the highly sensible freshwater pearl mussel (*Margaritifera margaritifera*). However, the literature also shows that good viable populations rather occur in river systems having mean nitrate concentration of < 10 mg/L. Higher Nitrate concentration are always a sign of a quite intensive managed catchment. Therefore, all efforts must continue to reduce the nitrate concentration and turbidity in both river systems.

Hydropeaking at the rivers Our and Sauer was discussed since 2014. The main problems with the Relles mill (Germany/ Luxembourg) and the Bigonville mill (Luxembourg) are not solved yet. The problems with the hydropeaking at the river Our/ Stoubach mill could be solved. The owner of the mill had to remove all the floating debris (e.g. wood, trash, which was deposit by the river at the dam). After this measure, the peaking decreased.

The hydro peaking at the river Our and river Sauer is ongoing. We were told by the Administration of Water (AGE) that the possibilities to stop the hydro peaking are limited. There is no chance that making a charge against the owner of the mill will go to court.

The AGE built a fish pass at the mill of Bigonville to avoid the peaking in the future. A defined minimum of water passes the channel.

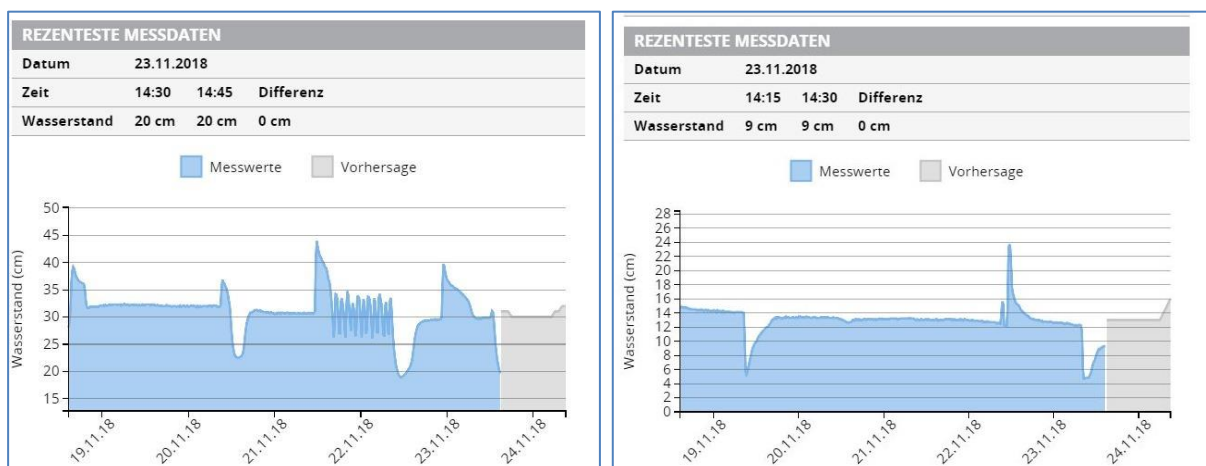


Figure 18: Hydropeaking at the river Our and the river Sauer

Since 2013, we collected 10 to 12 samples in springs and concentration of several metals and pesticides were determined by the laboratory of the Water Administration (see annex 33).

The use of Metazachlor is restricted. In drinking water zone it is forbidden and everywhere else it can be used every four years with a maximum amount of 750 g/ ha since February 2015. There is new restriction for Natura 2000 areas. Metolachlor is forbidden since February 2015.

The concentration of the degradation products of Metazachlor and Metolachlor in the last 4 years are shown in Figure 19 and Figure 20. The positive effect of these restrictions is clearly seen.

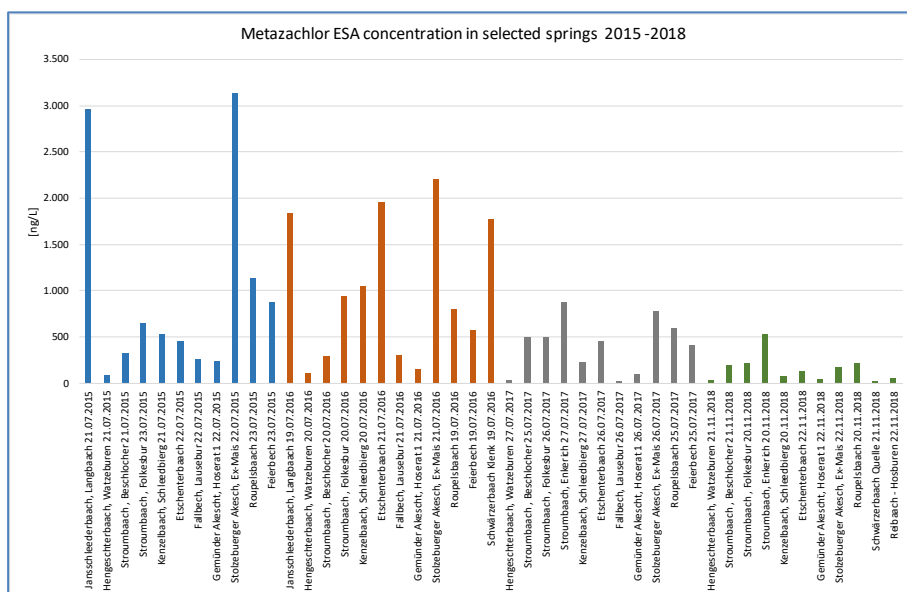


Figure 19: Metazachlor ESA concentration in the last 4 years (2015-2018)

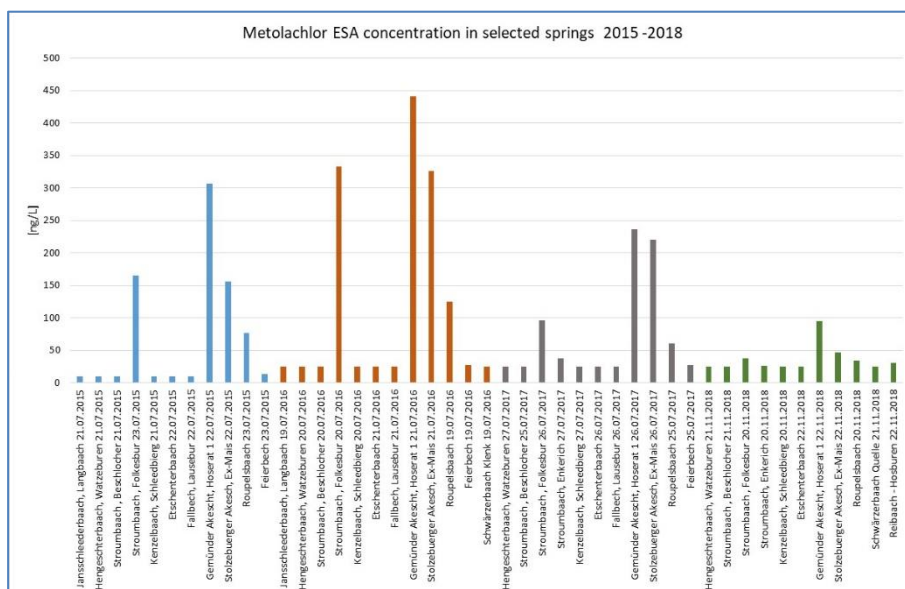


Figure 20: Metolachlor ESA concentration in the last 4 years (2015-2018)

Atrazin and its degradation products were detectable in the years 2013 to 2015. The concentration were smaller than 25 ng/L. Since 2016 the detection limit is 25 ng/L no Atrazin and its degradation products were detectable anymore.

Quality of interstitial

To have an overview of the quality of the interstitial, redox measurements were done (see more details under action D4). Additional the quality of the interstitial next to the mussel bank was monitored. Therefore, we took water samples from the bed, analysed the composition of the river bed and did redox measurements (see action D3).

5.1.12.3 Time schedule

| D1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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5.1.12.4 Indicators

Two water forums were organized in 2014, 1 forums in 2017 and 1 in 2018. The results of the monitoring during the project run time were presented at these forums (see for instance annex 12, submitted with progress report IV in March 2018 and Action E2).

5.1.12.5 Technical and / or financial modifications and justifications

No technical and or financial modification were necessary.

5.1.12.6 Problems encountered

During wintertime, the maintenance of both mobile probes is still difficult because of high water levels that can occur with high velocity. Therefore required calibrations are missing and some of the data cannot be used (see also D4, annex 37). For maintenance, both probes were sent to the company in July 2018. This took 4-month time, during which the probes could not be used. Because of less water in autumn and the problems during winter time (ice and floods) we did not used them since July 2018. It is planned to use them within the after LIFE programme next to mussel banks and on different tributaries. No further problems encountered.

5.1.12.7 Outside LIFE

No action.

5.1.12.8 Outlook

The water monitoring will go on in a small scale combined with the mussel monitoring in the AFTER LIFE Action plan. We will try to find additional funding ("Fonds de l'eau") in cooperation with COPIL to proceed the water monitoring as we did in the project (weekly Our and Sauer, tributaries every 3 months).

5.1.13 ACTION D2: MONITORING DES POISSONS HOTE

5.1.13.1 Expected results

This action should give an overview about the host fish population in both rivers (Our and Sauer) and their tributaries.

5.1.13.2 Activities and outputs

As foreseen, the composition of the fish fauna was investigated in 2013, 2015 and 2017 in both rivers at always two sites (Grossenauel and Dornaulsmühle at the river Our and Bigonville and Esperbësch at the river Sauer).

Table 20 and Table 21 summarise the species and number of individuals caught during the different events at the river Sauer and Our.

Table 20: Composition of the fish fauna in the river Sauer at two sites between 2013 and 2017

| River | Sauer | | | | | | |
|---------------------------------|------------|------|------|------------|------|-------|---------|
| Site | Bigonville | | | Esperbësch | | | Σ Sauer |
| Species / Year | 2013 | 2015 | 2017 | 2013 | 2015 | 2017 | |
| <i>Alburnoides bipunctatus</i> | 1 | 20 | 2 | 1 | 10 | 82 | 116 |
| <i>Barbatula barbatula</i> | 322 | 171 | 200 | 104 | 309 | 132 | 1238 |
| <i>Barbus barbus</i> | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| <i>Chondrostoma nasus</i> | 5 | 3 | 1 | 0 | 0 | 0 | 9 |
| <i>Cottus gobio</i> | 5 | 11 | 53 | 9 | 25 | 48 | 151 |
| <i>Gasterosteus aculeatus</i> | 0 | 26 | 42 | 0 | 0 | 0 | 68 |
| <i>Gobio gobio</i> | 33 | 120 | 273 | 11 | 47 | 130 | 614 |
| <i>Lampetra planeri</i> | 0 | 0 | 2 | 1 | 0 | 0 | 3 |
| <i>Pacifastacus leniusculus</i> | 0 | 0 | 14 | 18 | 58 | 13 | 103 |
| <i>Phoxinus phoxinus</i> | 126 | 675 | 1075 | 249 | 476 | 1170 | 3771 |
| <i>Salmo trutta fario</i> | 1 | 10 | 0 | 10 | 7 | 3 | 31 |
| <i>Squalius cephalus</i> | 0 | 8 | 3 | 0 | 1 | 5 | 17 |
| <i>Thymallus thymallus</i> | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| Σ | 495 | 1044 | 1667 | 403 | 933 | 1.583 | 6.125 |
| Number of fish species | 8 | 9 | 10 | 7 | 7 | 7 | |
| Number of crayfish species | 0 | 0 | 1 | 1 | 1 | 1 | |

The most abundant fish species in the river Sauer is the European Minnow (*Phoxinus phoxinus*). This fish species is also the most important host fish for the reproduction of the thick-shelled river mussel. With 7-10 fish species caught, we are also in the range of species that we would expect for this part of the stream.

Table 21: Composition of the fish fauna in the river Our at two sites between 2013 and 2017

| River | Our | | | | | | |
|---------------------------------|-------------|------|------|---------------|------|------|-------|
| Site | Grossenauel | | | Dornaalsmühle | | | Σ Our |
| Species / Year | 2013 | 2015 | 2017 | 2013 | 2015 | 2017 | |
| <i>Alburnoides bipunctatus</i> | 7 | 22 | 24 | 13 | 42 | 17 | 125 |
| <i>Barbatula barbatula</i> | 45 | 74 | 112 | 77 | 217 | 319 | 844 |
| <i>Barbus barbus</i> | 1 | 0 | 0 | 18 | 1 | 5 | 25 |
| <i>Chondrostoma nasus</i> | 0 | 0 | 2 | 6 | 0 | 6 | 14 |
| <i>Cottus gobio</i> | 48 | 94 | 178 | 14 | 58 | 98 | 490 |
| <i>Gasterosteus aculeatus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Gobio gobio</i> | 8 | 2 | 27 | 3 | 0 | 3 | 43 |
| <i>Lampetra planeri</i> | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| <i>Pacifastacus leniusculus</i> | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| <i>Phoxinus phoxinus</i> | 340 | 382 | 248 | 321 | 196 | 225 | 1.712 |
| <i>Salmo trutta fario</i> | 10 | 24 | 12 | 3 | 63 | 1 | 113 |
| <i>Squalius cephalus</i> | 7 | 0 | 3 | 10 | 0 | 6 | 26 |
| <i>Thymallus thymallus</i> | 0 | 0 | 4 | 0 | 0 | 0 | 4 |
| Σ | 466 | 601 | 610 | 465 | 577 | 683 | 3.402 |
| Number of fish species | 8 | 6 | 9 | 9 | 6 | 10 | |
| Number of crayfish species | 0 | 1 | 0 | 0 | 0 | 0 | |

The river Our shows a similar fish composition than the river Sauer. The European Minnow is, as for the river Sauer, the most abundant species and overall 6-10 species could be detected.

In both rivers, we checked the natural infestation rate with *Unio crassus* of different fish species. A natural infestation of minnows with glochidia from *Unio crassus* was visible in all three years of investigation for both rivers (see Figure 21 & Figure 22). Both parameters analysed (prevalence and mean abundance) were higher in the river Sauer.

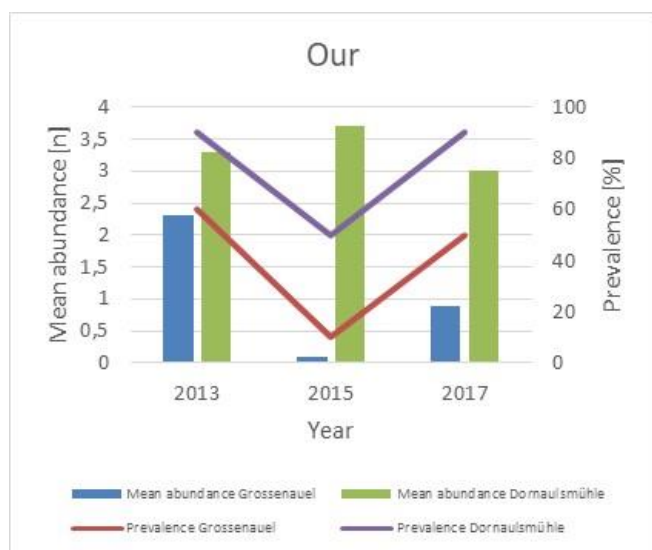


Figure 21: Mean abundance and prevalence of *Unio crassus* on minnows from the river Our

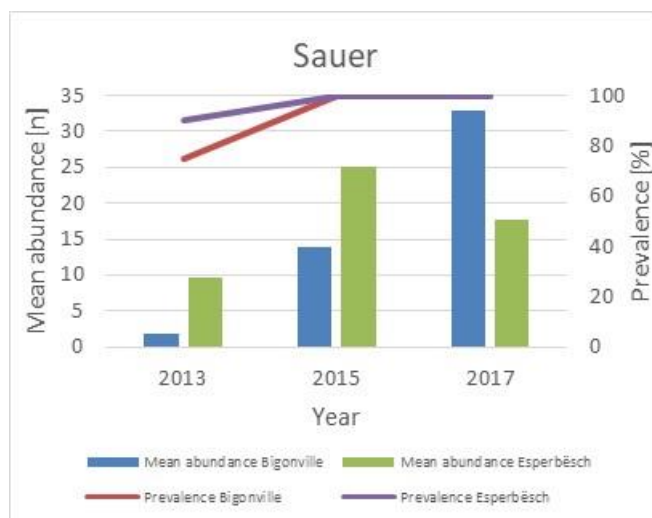


Figure 22: Mean abundance and prevalence of *Unio crassus* on minnows from the river Sauer

In 2013, the fish fauna of eight tributaries from the river Our and three tributaries from the river Sauer was investigated. This exercise was repeated in 2016 and 2018. In the last two years not all tributaries were analysed again but the focus was given to those tributaries where fish migration obstacles were already removed, or were foreseen to be removed (see also action C2 and D4). All tributaries monitored are part of the upper trout region and the expected two fish species Brown Trout and Bullhead were normally present (see Table 22 and Table 23). The transformations or removal of the obstacles was always successful. Although we checked the Froumicht and Houschterbaach immediately after the transformation, no fish species could be detected here so shortly after the transformation. It is intended to visit the last transformed migration obstacles again in 2019.



Figure 23: Electric fishing in a tributary

Table 22 and Table 23 summarise the electric fishing activities on the tributaries of both streams.

Table 22: Electric fishing activities on the river Our tributaries

| Date | Tributary | Sites | Species | Individuals |
|------------|------------|-------|---------|-------------|
| 02.12.2013 | Träsbech | 2 | 2 | 29 |
| 03.12.2013 | Fallbech | 1 | 0 | 0 |
| 03.12.2013 | Etterbaach | 1 | 0 | 0 |
| 03.12.2013 | Holzbech | 2 | 1 | 22 |

| | | | | |
|------------|------------------------------|---|---|----|
| 06.12.2013 | Housterbaach | 3 | 2 | 83 |
| 06.12.2013 | Gemünder Akeschterbaach | 1 | 1 | 30 |
| 03.12.2013 | Stolzebuerger Akeschterbaach | 2 | 1 | 6 |
| 05.12.2013 | Klangbaach | 1 | 1 | 23 |
| 23.11.2016 | Träsbech | 1 | 2 | 12 |
| 23.11.2016 | Housterbaach | 2 | 3 | 56 |
| 23.11.2016 | Gemünder Akeschterbaach | 2 | 1 | 7 |
| 23.11.2016 | Ruederbaach | 1 | 1 | 1 |
| 12.12.2018 | Housterbaach | 1 | 0 | 0 |
| 12.12.2018 | Ruederbaach | 1 | 1 | 1 |

Table 23: Electric fishing activities on the river Sauer tributaries

| Date | Tributary | Sites | Species | Individuals |
|------------|----------------|-------|---------|-------------|
| 04.12.2013 | Syrbaach | 3 | 8 | 132 |
| 04.12.2013 | Froumicht | 2 | 2 | 12 |
| 05.12.2013 | Schwärzerbaach | 3 | 2 | 71 |
| 30.11.2016 | Syrbaach | 1 | 5 | 64 |
| 30.11.2016 | Froumicht | 1 | 2 | 6 |
| 30.11.2016 | Schwärzerbaach | 3 | 1 | 14 |
| 12.12.2018 | Froumicht | 1 | 1 | 2 |
| 12.12.2018 | Schwärzerbaach | 1 | 1 | 1 |

5.1.13.3 Time schedule

| D2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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5.1.13.4 Indicators

From the nine host fish species known from literature, five species are present in the river Sauer and Our (*Chondrostoma nasus*, *Cottus gobio*, *Gasterosteus aculeatus*, *Phoxinus phoxinus* & *Squalius cephalus*). Although the three spined Stickleback is not listed in Table 20 and Table 21. It was nevertheless observed in the river Our, close to the Mill of Kalborn. In both rivers, the European Minnow (*Phoxinus phoxinus*), the best host fish in our region, is even the most abundant species. In both rivers the minnow always showed a natural infestation with larvae of *Unio crassus*, which is positive. Annex 34 gives further information about the monitoring of the fish fauna in the main streams and tributaries.

5.1.13.5 Technical and / or financial modifications and justifications

No technical or financial modifications were necessary in this action.

5.1.13.6 Problems encountered

No problems encountered

5.1.13.7 Outside LIFE

We share our results from the electric fishing activities with the water administration (AGE).

5.1.13.8 Outlook

It is intended to visit the last transformed migration obstacles again in 2019.

5.1.14 ACTION D3: SUIVI DE *UNIO CRASSUS* DANS SON MILIEU NATUREL

5.1.14.1 Expected results

The status of the *Unio crassus* populations in both rivers (Our and Sauer) was last investigated in 2003. To gain new information about the population size, age structure and habitat use, the intent of this action is to monitor the mussel population in both rivers.

5.1.14.2 Activities and outputs

Monitoring of the mussel population in Our and Sauer

The mussel survey in the river Our was finished in 2017. From the whole distance of 32 km, all 64 (500 meter) sections, which were accessible with the bathyscope, were prospected (30,5 km).

In the river Sauer one last 500 m section was finished 2018. All accessible sections (18,5 km from a total of 20 km) were prospected. Table 24 gives the overview of the mussels alive and empty shells counted during the surveys in the last years. Full details are available in annex 35.

Table 24: Counted mussels alive and empty shells in the river Our and Sauer

| | Our (32 km) | Sauer (20 km) |
|------------------------------------|-------------|---------------|
| Prospected [km] | 30,5 | 18,5 |
| Mussels alive [n] | 4.563 | 2.612 |
| Empty shells [n] | 1.805 | 3.545 |
| Proportion alive [%]/ dead [%] | 71,6 / 28,4 | 42,4 / 57,6 |
| Mean density [ind/m ²] | 0,03 | 0,03 |

Table 25 shows the recovery rates as determined during the mussels search at sites with tagged mussels in the river Our and Sauer during the last years.

Table 25: Recovery rate of tagged mussels in the river Our and Sauer

| Recovery Rate [%] | | | |
|-------------------|-------------------|------------|----------------------|
| River | Our | | Sauer |
| Year / Site | Wehr Kalbermillen | Kohnenhaff | Moulin de Bigonville |
| 2015 | 20,2 | 57,7 | 20,4 |
| 2016 | 11,2 | 46,9 | 14,4 |
| 2017 | 8,4 | 30,0 | / |
| Average | 29,1 | | 17,4 |

Taking into account these recovery rates and the number of observed mussels alive in the respective rivers, we can estimate the number of *Unio crassus* for the river Our to be around +/-15.000 animals and for the river Sauer to be around +/-14.000 animals. To strengthen and validate the estimations it is necessary to continue the determination of the recovery rates at the three sites with tagged mussels and to add more sites with tagged mussels. This was already done in 2017 as the mussels used for collecting glochidia were tagged and released back at their site of origin (see fertility control below).

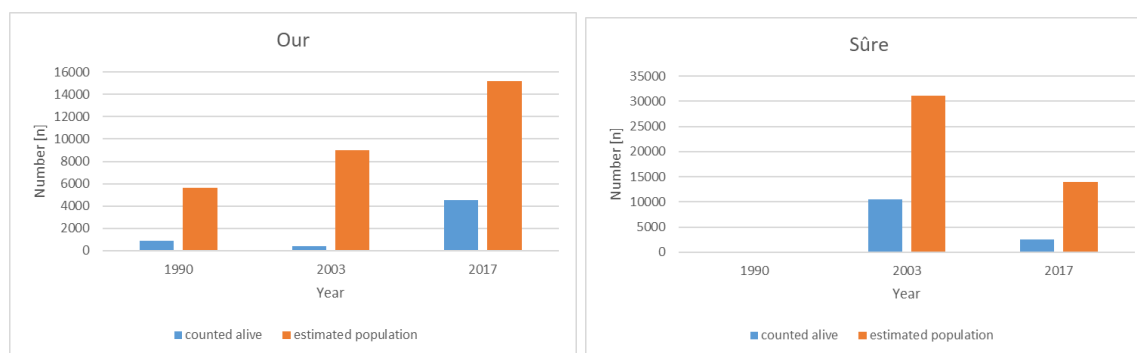


Figure 24: Development of the *Unio crassus* population in the river Our and the river Sauer

For both rivers, population counts and estimations are available from the past. For the river Our from 1990 and 2003, for the river Sauer only from 2003. As Figure 24 shows, the population in the river Our shows an improvement with an increase of the population during the last years. In the river Sauer however, we observe a massive decline between 2003 and 2017. The reason for the decline in the river Sauer is not completely clear for us. Some of the water parameters (see Table 19), like for instance the turbidity, conductivity and ammonium are slightly higher compared to the river Our and might already be less favourable. Furthermore, on the 17th of September 2014 there was an accident with an agricultural spraying machine for pesticides and 9000 Litres, containing 10 Litres of the pesticide himself (PAPSAN, active component = METAZACHLOR used in colza cultures) run into a tributary of the river Sauer +/- 20 km upstream from the Luxemburgish border.

In their first estimation (November 2014) the Belgium colleagues estimated a mortality between 20-90% among the *Unio crassus* population in the Belgium part of the river from the accident site to the Luxemburgish border. A more detailed study in 2015 confirmed that the mortality among Uc as compared to an unimpacted reference site was about 78%. However, we could not observe a higher proportion of empty shells in the Luxemburgish part of the river Sauer during our surveys after September 2014. The dilution effect from the spill place to the border helped that in the Luxemburgish section not acute mortality could be observed. As it was only by chance that the accident was reported it can not be excluded that in the period between 2003 and 2014 already other similar accidents occurred, having an effect on the mussel population. Not underestimated should also be the negative effect of the muskrat on the mussel population before the start of the LIFE project between 2003 and 2012.

In the village Untereisenbach two weirs used to supply mills with water. Within an Interreg project both weirs were almost completely or partly removed and become again passable for fish. The lower weir, which was only partly removed, still supplies the old mill channel with water. Our mussel mapping showed that the old mill channel is populated by *Unio crassus* and *Anodonta anatina* and *Rhodeus amarus*. Further details about this monitoring can be found in annex 36 and chapter 5.4.1.2.

Age determination of mussels in Our and Sauer

Shells from 136 *Unio crassus* (empty shells) were collected from a population in river Our (Luxembourg) and from two population in river Sauer (Luxembourg and Belgium). The shells were measured for length, width and height. Thin transverse section were made, coloured and etched. This method is used to see the winter lines. The summary of this external assistance study is seen in Figure 25 (the full report of this external assistance was submitted as annex 22 with the mid-term report in March 2015).

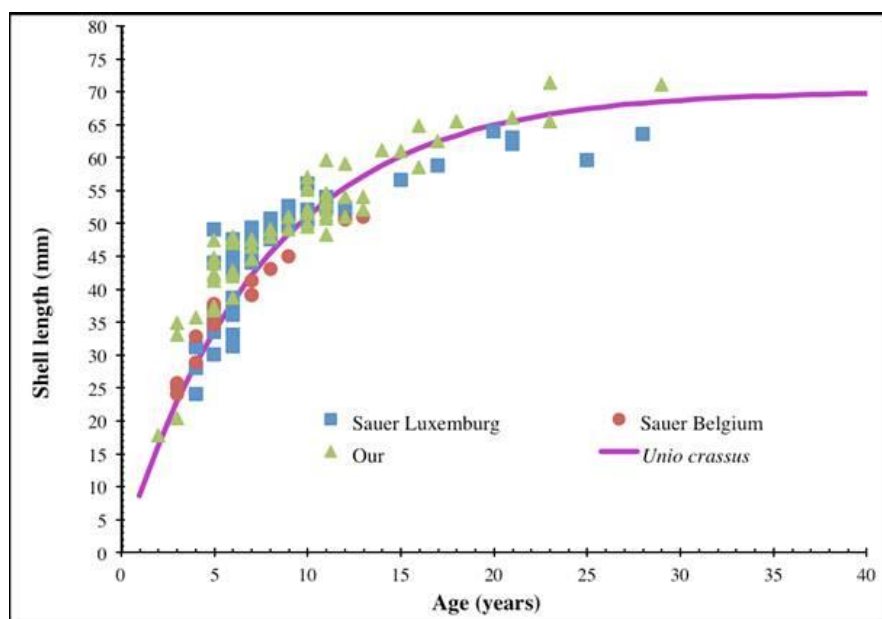


Figure 25: Diagram showing a general growth curve for *U. crassus* in Luxembourg region

Figure 25 shows for both rivers a typical growth curve for this freshwater mussel species. A relatively fast growth until 5-10 years are reached. After 10 years, when all mussel should have become sexually mature, the growth slows down, as with further growth more and more energy is used for reproduction, rather than for getting larger. For both rivers, the mussel reach a maximum age of +/- 30 years.

Tagged mussels in the rivers Our and Sauer

Mussels used for breeding and mussels of an area with a high density were tagged and controlled regular. We had 4 sites in the river Our and 2 sites in the river Sauer.

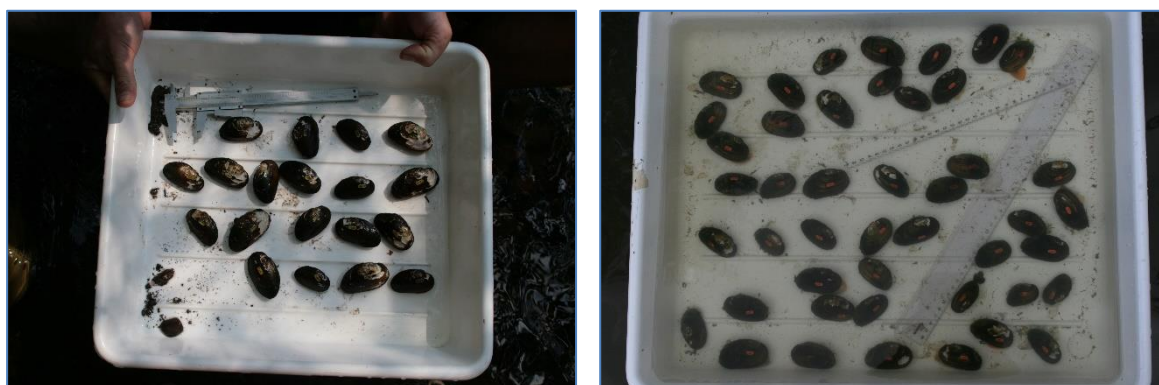


Figure 26: Tagged mussels in Our and Sauer

The sites were checked yearly and the recovery rate determined (see Table 26).

Table 26: Recovery rates at the different mussel sites

| River | Sites | Total | ??? | Recovery rate | | | | | |
|-------|-----------------|-------|-----|---------------|-------|------|------|-------|------|
| | | | | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Our | Kalbornermillen | 407 | 144 | --- | Start | 14% | 11% | 6% | 5% |
| Our | Tintesmillen | 136 | 136 | --- | --- | --- | --- | start | 52% |
| Our | Kohnenhaff | 114 | 71 | start | --- | 48% | 38% | 29% | 28% |
| Our | Stozemburg | 52 | 52 | | | | | start | 58% |
| Sauer | M. Bigonville | 242 | 242 | --- | start | 8% | 5% | 1% | 4% |
| Sauer | M. Oeil | 217 | 111 | --- | --- | --- | --- | start | 46% |

Sediment analysis

Probes (+/-2.000g) were collected with buckets (2 litres) on the mussel banks. The grain mixture is quite similar at all the locations (see Figure 27).

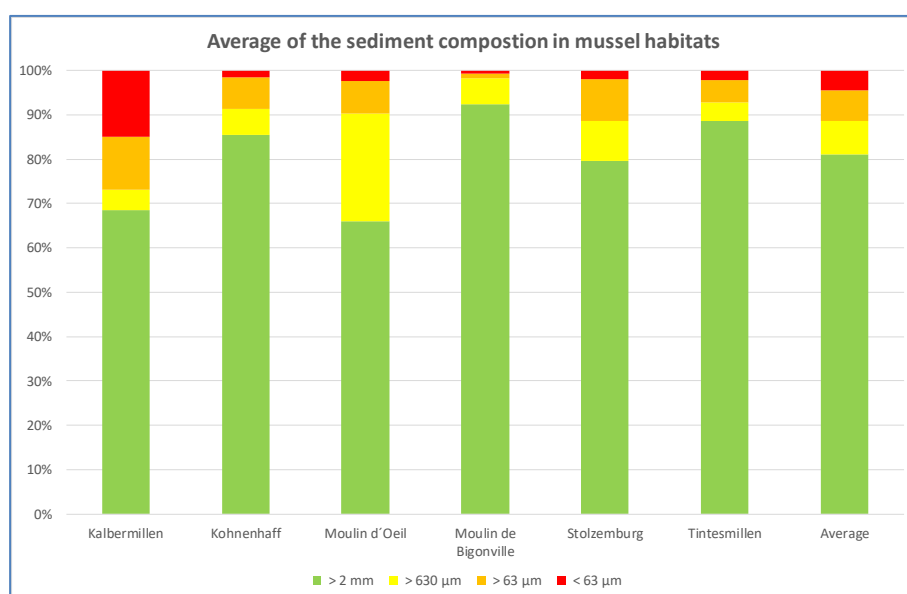


Figure 27: Sediment analysis of different mussels habitat – average of all samples is shown

About 81% is formed by the fraction >2mm, whereas between 8 and 2% is >630 µm, about 7% > 630 µm and less than 5% < 63 µm (for details check annex 35).

Fertility control

The fertility control always occurred during the collection of the adult mussel for the breeding process (see Table 10 under action C4). By slightly opening the shell with a special designed forceps, the gills of the mussels become visible. Seeing swollen and beige-orange coloured gills indicates that already developing eggs have been deposited in the mantle cavity of the mussel. The fertility was never checked on all collected animals in the respective years, but only on a few animals to minimize the stress to the mussels. It was possible to collect glochidia in every year of the project runtime.

Survival rate of the juvenile mussels

The rearing procedure shown in Figure 28 gives the survival rates observed during the last years in the

respective steps. In every step, there is a loss of mussels.

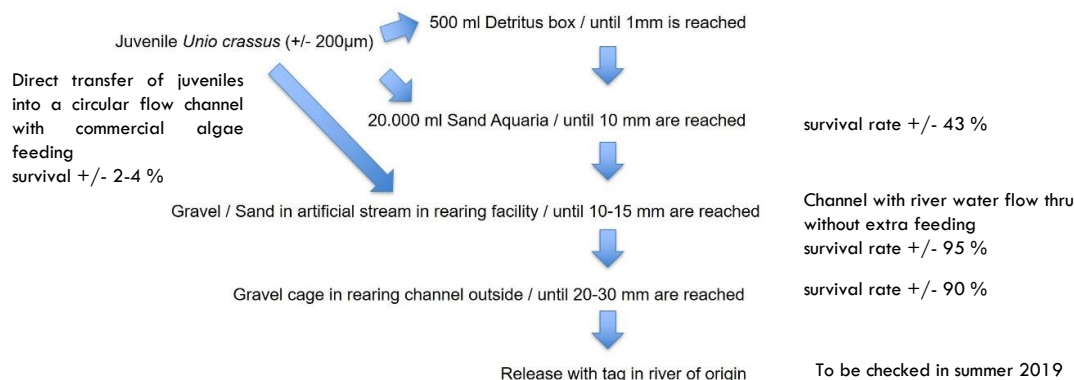


Figure 28: Rearing procedure with the survival rates in the respective steps

Applying the following procedure: freshly dropped mussels → detritus Box → sand aquaria → river water flow thru channel → outside channel → release, we get a total survival of around 12-15%.

This is acceptable and allowed us to produce +/- 1.000 mussels per stream /year. Unfortunately, the less time-consuming method putting high numbers of freshly drooped mussels directly in a circular flow channel with commercial algae feeding had only a low survival rate of 2-4%.

This had not direct impact on the project, as this method was not foreseen from the beginning. However once optimized, and as we were mostly able to collect >5.000 juvenile mussels, this method could help to release much more mussels to the streams to strengthen the population.

5.1.14.3 Time schedule

| D3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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5.1.14.4 Indicators

The report of “Age determination of *Unio crassus* shells from Sauer and Our rivers” was finalised in June 2014. Every year we tagged mussels in each river to determine the recovery rate. Every year, we were able to collect fertile mussels to receive glochidia for the culture.

5.1.14.5 Technical and / or financial modifications and justifications

There was a slight technical deviation that only 30,5 km at the river Our and 18,5 km at the river Sauer were prospected. The remaining areas were in the backwater of larger dams and it was impossible to monitor such locations by wading. This was granted by the EC in the letter dated on 15/05/2018.

No other technical or financial modification were necessary.

5.1.14.6 Problems encountered

No problems encountered.

5.1.14.7 Outside LIFE

No action.

5.1.14.8 Outlook

The monitoring of the mussels sites is foreseen in the After Life conservation plan.

5.1.15 ACTION D4: MONITORING ET EVALUATION DE L'IMPACT DES MESURES CONCRETES

5.1.15.1 Expected results

The aim of this action is to develop and apply a pre- post-monitoring protocol in order to evaluate the effectiveness of the used restoration methods.

5.1.15.2 Activities and outputs

The initial status quo of water quality and population of *Unio crassus* will be used as reference for the evaluation of prospective measures.

The success of the restoration measures was evaluated by the monitoring of concrete parameters (water quality, turbidity, quality of substrate and the host fish population). On selected places, with implemented measures (as detailed in Table 27 below) an intensive monitoring was done. This means, that on these sites a water sample was taken once per week, sediment traps were installed, interstitial quality was measured and the host fish population was monitored.

The monitoring of the water quality of the rivers Our, Sauer and their tributaries is described in action D1.

The riverbeds downstream of the gravel input were monitored. Therefore, we measured the redox potential in the free flowing water and in the interstitial at 5 cm depth (2014 to 2017). The average ratio between 5 cm depth and the free water was in the river Our about 45% and in the river Sauer about 36%. This means, that it comes to a loss of oxygen of about 55% in 5 cm depth in the river Our. In the case of river Sauer we had a loss of more than 64%. The average ratio is very low but it fits with the annual mean of the turbidity. The turbidity in the river Sauer (8,7 FNU) is higher than in the river Our (5,9 FNU), which partly explains these redox results. Recent studies showed that *Unio crassus* is, in contrast to the highly sensible freshwater pearl mussel (*Margaritifera margaritifera*), able to tolerate much higher levels of fine sediment deposition (Deniv M., Stoekl K., Gum B. & Geist J. (2013) Physicochemical assessment of *Unio crassus* habitat quality in a small upland stream and implications for conservation. Hydrobiologia DOI 10.1007/s10750-013-1467-z). In addition, a much higher loss of redox in the substratum is tolerated by *Unio crassus* compared to *M. margaritifera*. However, a loss of 50-65 % as described above is always a sign of a high sediment deposition rate and an intensive managed catchment. Even if *Unio crassus* can handle this effect to some extent everything should be undertaken to reduce the amount of fine sediments, entering our river systems.

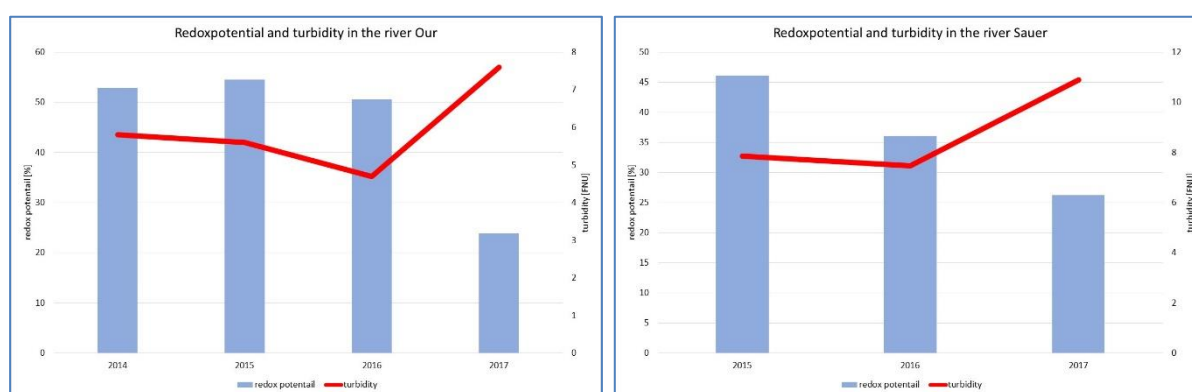


Figure 29: Redox potential and turbidity in the river Our and Sauer

The redox potential is strongly influenced by the amount of rain, the debit and the velocity of the water (see annex 37). Additionally we monitored the distribution of the gravel in the riverbeds of Our and Sauer (see C3, annex 26).

The composition of the host fish population was monitored at all relevant sites (see action D2 above).

The summary of the evaluations of all measures (C1 to C3) can be found in Table 27.

Table 27: Overview over implemented measures and their monitoring programme

| River | Tributary | Measures | Water quality | | Sediment traps | | Interstitial quality | | Host fish population | |
|-------|--------------------------|-----------------------------------------------|---------------|---------|----------------|---------|----------------------|---------|----------------------|----------------|
| | | | monitored | changes | monitored | changes | monitored | changes | monitored | changes |
| Our | Roupelsbaach | Fencing spring and stream | yes | → | yes | → | no | --- | no | --- |
| Our | Folkesbur | Fencing spring and stream | yes | ↗ | yes | → | no | --- | no | --- |
| Our | Bollertsbaach | Fencing and watering place | no | --- | no | --- | no | --- | no | --- |
| Our | Enkerich | Fencing and watering places | no | --- | no | --- | no | --- | no | --- |
| Sauer | Froumicht ¹ | Fencing | no | --- | no | --- | no | --- | no | --- |
| Sauer | Sauer | Fencing and watering places | no | --- | no | --- | no | --- | no | --- |
| Our | Feierbech | Pilot project Feierbech | yes | → | no | --- | no | --- | no | --- |
| Sauer | Schwärzerbaach | Remove 3 tubes and build bridges | yes | → | yes | → | yes | → | yes | ↗ |
| Sauer | Syrbaach ¹ | Restore of a ford | yes | → | yes | → | no | --- | yes | → |
| Our | Ruederbaach ¹ | Building a bridge and creating a new riverbed | yes | → | no | --- | no | --- | yes | ↗ |
| Our | Huschterbaach | Remove tube and build a bridge | yes | → | no | --- | no | ---- | yes | → |
| Sauer | Froumicht ¹ | Remove tube and build a bridge | | → | no | --- | no | --- | yes | → ² |
| Our | Feierbech | Remove tube and build a bridge (Outside LIFE) | no | --- | no | --- | no | --- | no | --- |
| Our | Our | Gravel | yes | → | no | --- | yes | ↗ | yes | ↗ ³ |
| Sauer | Sauer | Gravel | yes | → | no | --- | yes | ↗ | yes | ↗ ³ |

¹ income of sewage water, less to no monitoring² control after 1 month and less water – no statement possible³ fish population changes per season and year, weather and discharge, but a trend is visible

→ no or less changes, ↗ changes were observed

The monitoring of the *Unio crassus* population in its natural environment started in spring 2013 (see D3).

The mussel breeding started in spring 2013 (see C4). The technical report about *Unio crassus* rearing with discussion of results is available in English and German (see A4). Growth and survival of the cultured mussel was always followed and the results are discussed in the technical report and in this report under action D3. In 2014 first *Unio crassus* were released in gravel cages in the rearing channel at the mill of Kalborn. Also in the following years, 2015, 2016, 2017 and 2018 we continued releasing mussels with gravel cages in the rearing channel. As these are the mussels, which will normally be released in the following year and as these mussels are already in contact with their natural environment (river water) without extra feeding we carefully followed the development of these animals. Figure 30 shows the results obtained from all cages checked in June 2018. All these mussels were released in 2018. 11 new cages were filled with 1.266 mussels (555 Our & 711 Sauer) between June and July 2018. Overall 85% of the mussels had survived to date, which is a positive development. An average growth of 250% was obtained after 4 years (from 14mm to 36 mm) which we also evaluated as good. The slight increase in survival over time is due to the fact, that every year a higher number of new mussels was added with new cages which showed a better survival and thus the overall survival increased.

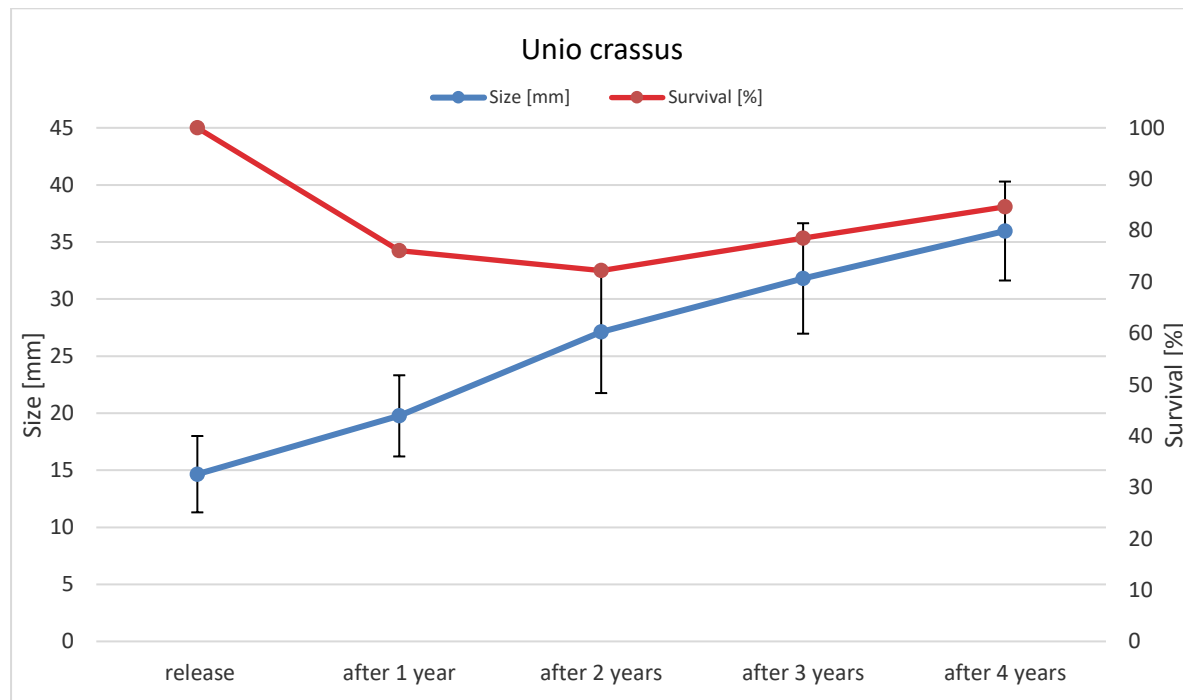


Figure 30: Survival and growth of the mussels released in gravel cages

A good overview about water quality (D1), host fish population (D2) and *Unio crassus* population (D3) is achieved.

5.1.15.3 Time schedule

| D4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | realized |

5.1.15.4 Indicators

The evaluation report about the implemented measures can be found in annex 37.

5.1.15.5 Technical and / or financial modifications and justifications

No technical or financial modification were necessary.

5.1.15.6 Problems encountered

The evaluation of the gravel banks at the river Sauer was only possible in the years 2015-2017. First, there were some problems with the Belgian authorities (see C3). Second, the last input happened in March 2018 because of a very mild winter. Therefore, the gravel was not washed down to the river.

5.1.15.7 Outside LIFE

No action.

5.1.15.8 Outlook

The gravel banks will still be monitored in the future to see any change in the redox potential and the fish population.

5.1.16 ACTION D5: ANALYSE DE L'IMPACT SOCIO-ECONOMIQUE DU PROJET ET DE L'EFFET SUR LES ECOSYSTEMES

5.1.16.1 Expected results

The objective is to assess the impact of the LIFE Nature project on the ecosystem services provided and on the welfare of the region and its populations.

5.1.16.2 Activities and outputs

In 2017, the Luxembourg Institute of Science and Technology (LIST) carried out a study, focusing primarily on the ecosystem services provided by the LIFE Resto Unio project. The outcome of the study showed, that the project was able to improve carbon sequestration, water retention (water yield) and to a low extent the sediment export in the project areas. Furthermore, cultural services and other socio-economic benefits were also apparent. Especially the Natura 2000 room and the high number of children and adults (8.300) educated during the project runtime are worth to be mentioned.

In addition, the ecosystem services directly provided by the released *Unio crassus* are not negligible. The release of 2.000 mussels per river (2.000 in 2018 and another 2.000 will be released in early summer 2019) will provide a filtration capacity of around 36 million litre per river per year.

5.1.16.3 Time schedule

| D5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.16.4 Indicators

We did not produce two reports, but the report from the LIST includes both aspects, the socio economic context and the effect of the restauration work on the ecosystem. The emphasis of the LIST report is given to the ecosystem services aspect (see full report in annex 38).

5.1.16.5 Technical and / or financial modifications and justifications

The cost for the external assistance from the LIST were not foreseen. As the study was conducted with the aid of a trainee-student supervised by an expert, the cost were not elevated and we were able to finance the study within the framework of the LIFE project. Real cost for such a study can be up to several 1.000 € as a mail offer from Dr. Benedetto Rugani from the LIST showed (see annex 39).

5.1.16.6 Problems encountered

The study from the list used all the data available by the year 2017. Most of the restoration work and land acquisition was done by that time. However, some more detailed information were only available after 2018 and could not be integrated into the study. Even if the last few measures would have been integrated, the overall outcome of the study would not have been changed.

5.1.16.7 Outside LIFE

None.

5.1.16.8 Outlook

It is foreseen to publish the results of the LIST study in a scientific paper.

5.1.17 ACTION E1: INFORMATION ET SENSIBILISATION DES ACTEURS CONCERNES

5.1.17.1 Expected results

The intent of this action is to build up a network with all authorities and stakeholders, having an influence and impact on the water quality of the two rivers of concern and their tributaries. The regular exchange with these stakeholders should help to implement the restoration work foreseen under C1, C2 and C3. Furthermore, the exchange with farmers and authorities from the neighbour countries should be fostered.

5.1.17.2 Activities and outputs

During the project runtime, almost 200 meetings with the different stakeholders (local community, Water Administration, Administration responsible for the road constructions, Ministry of the environment, Nature parks, Nature and Forest Administration, Chamber of agriculture, LIST, German and Belgian Administrations...) took place. This intensive exchange helped realizing all the restauration measures mentioned under C1, C2 and C3. Also many other actions e.g. C4, C5 and D actions benefited from this exchange. Details about the activities to raise awareness among the stakeholder can be found in annex 40.



Figure 31: Information event for farmers and second water forum for the river Sauer catchment

5.1.17.3 Time schedule

| E1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.17.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|----------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 water forums | 30.09.2014 | 1 st river Our 02.04.2014 (20 participants) 1 st river Sauer 12.11.2014 (12 participants) |
| | 30.09.2016 , changed to late 2017 early 2018 as the project got extended by 1 year | 2 nd river Our 22.11.2017 (26 participants) 2 nd river Sauer 17.04.2018 (16 participants) |
| 5 information events for farmers | No deadline | 1 st on 27.11.2013: Loss of soil through water erosion - protect soil using good practice methods (70 participants). 2 nd on 04.03.2015: Use of pesticides. How can negative effects be reduced (40 participants). 3 rd on 23.09.2015: Soigner la terre pour nourrir les hommes/ practical field event with 25 participants and evening seminar with 50 participants. 4 th on 12.07.2017: Change the farming practices into a more sustainable direction (20 participants). 5 th on 07.02.2018: Importance of small streams for mussel population and public wellbeing (50 participants). |
| Leaflet for the farmers | No deadline | Printed in January 2019 and send to 1.668 farmers in February 2019 (overall 1800 copies were printed). The complete leaflet can be found in annex 41. |

The outcome of the four water forums (2 for the river Our catchment and 2 for the river Sauer catchment) was, that a good exchange with the different stakeholders from the other countries of the two transborder catchment took place. The meanwhile established network of people made and makes the exchange with the experts from the other countries much easier and helps to detect and solve problems much faster.

The outcome of the five water forums was that around 250 farmers could be informed about better farming practices, reducing the erosion, improving the soil and reducing the impact of pesticide use. Furthermore, the farmers got information's about the importance of freshwater ecosystems for the society, and how they can get financial support, applying some of these best practices on their farms. The content of the 5 events was also summarized in the leaflet for farmers which was send to all farmers in Luxembourg at the end of the project.

5.1.17.5 Technical and / or financial modifications and justifications

As the project runtime was extended by one year, the second water forums took not place in 2016 but in 2017 and 2018.

5.1.17.6 Problems encountered

No problems encountered.

5.1.17.7 Outside LIFE

No activities outside LIFE.

5.1.17.8 Outlook

The network with stakeholders establish during the LIFE Resto Unio programme will also be useful to continue parts of the work in the after LIFE programme.

5.1.18 ACTION E2: SENSIBILISATION DU GRAND-PUBLIC

5.1.18.1 Expected results

This action intends to inform people about the importance of the Natura 2000 network and the overall intent of the project by the following means: Information of the population at the begin and the end of the Project, press release, project flyer, notice board, movie (film), exhibition, layman report, Natura 2000 visiting room.

5.1.18.2 Activities and outputs

We were quite successful in informing people about the importance of our natural freshwater resources and the content of the LIFE Resto Unio project. Overall, 8.284 people of all ages got informed during visits at the mill of Kalborn and during the participation of the LIFE Unio team at different fairs (26 events). Figure 32 shows the development of the people informed during the different years. A list with the visitors from the respective years and pictures of the notice boards, Natura 2000 room etc. can be found in annex 42.

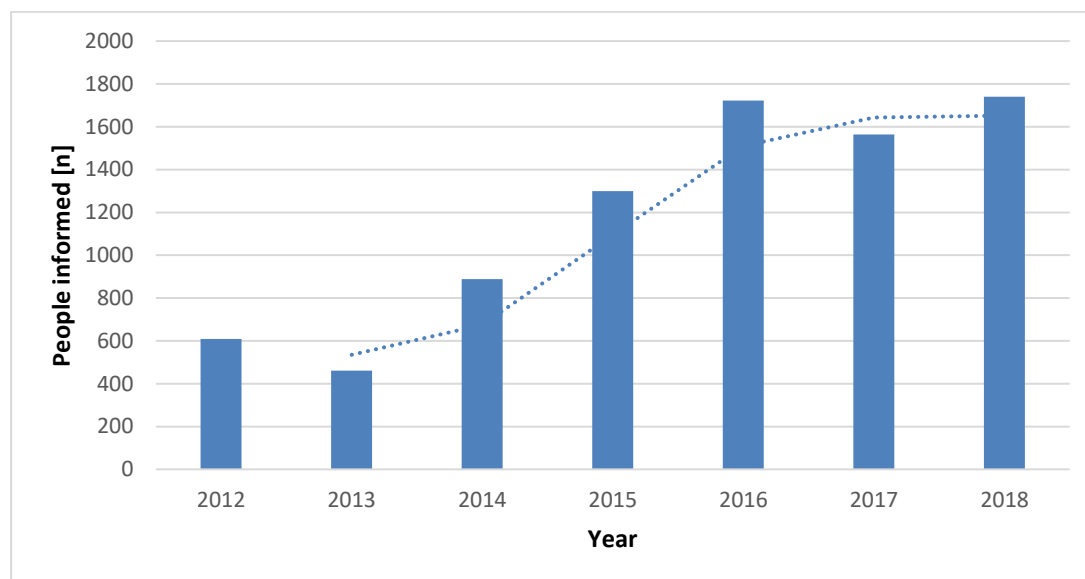


Figure 32: Public awareness trough the project time



Figure 33: School class at the mill and information event at the “Naturparkfest” Our

5.1.18.3 Time schedule

| E2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.18.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|----------------------------|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Two kick off events | 31.01.2013 | 12.12.2012 River Our project area, centre culturel Munshausen (+/- 100 participants). 20.02.2013 River Sauer project area, centre culturel de Boulaide (55 participants). See annex 43. |
| Two closing events | No deadline | 27.11.2018 River Our project area, centre culturel château Clervaux (24 participants). 06.02.2019 River Sauer project area, centre culturel de Boulaide (25 participants). See annex 43. |
| One Flyer | 31.08.2013 30.04.2014 14.10.2014 | The flyer is available with a delay of 9 month since April 2014 in German (2.000 printed) and since October 2014 in French (1.000 printed), and English (1.000 printed). Most of the flyers have been distributed during the project runtime. See annex 44. |

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|---------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 Exhibition boards | 31.01.2014 | <p>Five exhibition boards were produced in 2012 and seven more in 2016 to complete the Natura 2000 room. All boards are permanently installed at the mill of Kalborn. The seven later exhibition boards could not be produced earlier, as they had to fit into the Natura 2000 room.</p> <p>See annex 45.</p> |
| Two outside Information boards | No deadline | <p>The two Information boards, highlighting the ecosystem services freshwater mussels provide, were fix installed at the mill of Kalborn and at the confluence of the tributary Schwärzerbaach with the river Sauer.</p> <p>See annex 45.</p> |
| One movie | No deadline | <p>One movie (9 min) focusing on the ecosystem services, the thick shelled river mussels provides by their filtering capacity, with German, French, English and Dutch subtitle was produced.</p> <p>https://www.youtube.com/watch?v=8DLQ-S-S9-U</p> |
| One Natura 2000 room | No deadline | <p>The Natura 2000 room was installed and is open to the public since autumn 2016.</p> <p>See annex 42.</p> |
| One Layman report | <p>31.08.2017</p> <p>changed to late 2018 as the project got extended by 1 year</p> | <p>The Layman report is available in a printed and online version since 26.11.2018 in three languages (400 French, 400 German and 200 English).</p> <p>See annex 46.</p> |
| Press releases | No deadline | <p>92 press releases, four radio interviews and four appearances on TV (see annex 47).</p> |

5.1.18.5 Technical and / or financial modifications and justifications

The movie, which includes many animations, produced by a professional graphic design company, became more expensive than foreseen 20.609,88 € versus 10.000€. However, due to saving in other parts of the E2 action, we were able to cover these extra costs. Furthermore, we did not produce a DVD hard copy of the movie. In times of online media, this is not necessary as we learned from a former LIFE project where many hard copies were left over.

5.1.18.6 Problems encountered

No problems encountered.

5.1.18.7 Outside LIFE

Due to sponsoring from the Luxemburgish Lotto company fund (Œuvre Nationale de Secours Grande-Duchesse Charlotte) and the water programme of the HSBC Bank, we were able to renovate the main building at the mill of Kalborn and equip a classroom with furniture and more optical equipment (binocular microscopes). With the follow up of a leader programme we were also able to equip the classroom with high quality microscopes.

5.1.18.8 Outlook

In the After LIFE, the action to inform the population about NATURA 2000 and the importance of freshwater ecosystems is scheduled.

5.1.19 ACTION E3: CRÉATION D'UN SITE WEB

5.1.19.1 Expected results

The project homepage will give the opportunity to inform all interested persons about the progress of project. Furthermore, technical documents, provided as download, should help other projects working in a similar field.

5.1.19.2 Activities and outputs

The internet domain name www.unio.lu was reserved right after the start of the project. Already in June 2013, the website was fully functionally in all three languages (French, German and English). The website is used to inform people about the species of concern and their risks, the project area, the LIFE programme and the Natura 2000 network. On a monthly basis, news were added to inform visitors about the progress of the project. In addition, under the heading project data it is possible to download all technical reports and progress reports. Figure 18 shows the increase in visitors per month during the project period. Unfortunately, the statistical tool of the website was changed in 2018 so that no comparable information's are available for 2018. However, we assume that the number of visitors/month stayed at least at the same level than in 2017.



Figure 34: Visitors of the homepage per month during the project period

The website and the contact form are fully functional and will stay online for at least the following 5 years.

5.1.19.3 Time schedule

| E3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.19.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|---------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Functional website | 30.04.2013 June 2013 | With a slight delay of two month, the website is fully functional since June 2013. On average we have +/- 519 visitors per month. |

5.1.19.5 Technical and / or financial modifications and justifications

No technical or financial modifications were necessary in this action.

5.1.19.6 Problems encountered

No problems.

5.1.19.7 Outside LIFE

No outside LIFE activities.

5.1.19.8 Outlook

The website will remain fully functional for at least the next five years.

5.1.20 ACTION E4: ORGANISATION DE SEMINAIRES

5.1.20.1 Expected results

To promote the scientific exchange with other LIFE projects or other scientists working in the same field, two scientific seminars are planned within the project.

5.1.20.2 Activities and outputs

A first seminar, with focus on freshwater mussel rearing, was scheduled for the first half of the project runtime. It took place between Tuesday 24th and Thursday 27th November 2015 in the castle of the city Clervaux. With 81 participants from 20 countries, the seminar was well visited by an international audience. 26 oral presentations and 22 poster presentations were given. The seminar ended with a visit of the freshwater mussel rearing facility at the mill of Kalborn. After the first seminar, Megan Bradley who also participated at the seminar and gave an oral presentation, stayed for three more days and helped us with experiment using the cell counter (see also Action A4).

The second seminar, with emphasis on monitoring and restauration work in freshwater habitats, was held between Tuesday 27th and Thursday 29th November 2018 at the same location than in 2015. Overall 56 people from 15 countries participated. 17 talks and 7 poster presentation filled the programme. A hike along the river Our from the three border triangle to the mill of Kalborn finished the seminar.

The summary as well as the abstract book of both seminars is still available under news on the internet site (see also annex 48).



Figure 35: 2nd Seminar in Clervaux, group Photo and fieldtrip

5.1.20.3 Time schedule

| E3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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1 - 1st seminar, 2 - 2nd seminar

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5.1.20.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| First international seminar | 31.01.2014 24-27.11.2015 Delayed to the year 2015 as in the year 2014 many other conferences dealing with freshwater mussels took place | The first seminar with 81 participants from 20 countries took place at the end of November 2015. See annex 48. |
| Second international seminar | 31.05.2017 27-29.11.2018 Shifted to 2018 as the project got extended by 1 year | The second seminar with 56 participants from 15 countries took place at the end of November 2018. See annex 48. |

5.1.20.5 Technical and / or financial modifications and justifications

No technical or financial modifications were necessary in this action.

5.1.20.6 Problems encountered

As many conferences dealing with freshwater mussels took place in Europe in 2014 and in order not to compete with these events, we decided to organise the first seminar in 2015. Due to the extension of the project by one year, the second seminar took place in 2018.

5.1.20.7 Outside LIFE

None.

5.1.20.8 Outlook

No other international seminars are scheduled in this After LIFE project.

5.1.21 ACTION F1: GESTION ET ENCADREMENT DU PROJET

5.1.21.1 Expected results

The aim of the action is to monitor and analyse the realisation and expenses of the actions.

5.1.21.2 Activities and outputs

The administration of the project was responsible for the process and the financial situation during the runtime. This included the organisation of the meetings with the members of the piloting committee once a year (2 meetings in the first year).

The meetings took place: 30.11.2012, 10.07.2013, 01.10.2014, 09.12.2015, 14.12.2016, 15.01.2018, 11.02.2019.

The project team changed in the runtime because of personal issues (see 4.1.1). A detailed description of the administration and the people involved and their respective task within the project can be found in chapter 4.



Figure 36: LIFE Unio team Sonja Heumann, Frankie Thielen, Karin Michels, Manou Schirtz, Patricia Heinen (September 2018)

5.1.21.3 Time schedule

| F1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|-----|----|-------------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.21.4 Indicators

| Deliverables/ milestones | Deadline | Progress |
|-------------------------------|------------|-------------------------------------------------------------------------------------------|
| Réunion du comité de pilotage | 30.11.2012 | In the first meeting, the project was presented to all members of the comité de pilotage. |

5.1.21.5 Technical and / or financial modifications and justifications

A request for a project prolongation and financial shifts was introduced to the European Commission on 27.05.2016. The project prolongation till 28.02.2019 was accepted on 21.07.2016 (see annex 4).

5.1.21.6 Problems encountered

No problems encountered.

5.1.21.7 Outside LIFE

No action.

5.1.21.8 Outlook

No action is foreseen.

5.1.22 ACTION F2: ECHANGE DU SAVOIR AVEC D'AUTRES PROJETS: LIFE ET AUTRES

5.1.22.1 Expected results

The intent of this action is the regular exchange with all other project (LIFE, but also others) working in the field of freshwater mussel conservation. This achieved by attending scientific meetings and regular email exchange with other experts.

5.1.22.2 Activities and outputs

Especially at the beginning of the project (years 2013 & 2014) we actively participated to several scientific conferences (6 in 2013 and 4 in 2014). All other years we participated at least to one scientific meeting. This helped to build up a scientific network, which could be used for knowledge exchange as well as to discuss specific issues of different problems related with the project. We were able to have contact with persons from most European countries and with many persons from the United States. As the eastern parts of the United States harbour a high diversity of freshwater molluscs, a lot of expertise is available in this part of the USA. We participated, as planned in this action, at the Freshwater Mollusk Conservation Society (FMCS) meeting in Alabama in 2013. This trip was combined with the cell counter training (see Action A4). As the travel budget was far from being exhausted, we participated with the approval from the EU also at the FMCS meeting in 2017 in Ohio (granted from EC, see annex 19 submitted with the progress report IV in March 2018).

The knowledge exchange mainly worked by email contact and the following contacts need to be highlighted:

- UC for Life Sweden (<http://www.ucforlife.se/en/>).
- Jürgen Geist Group TU München (<http://fisch.wzw.tum.de>).
- Megan Bradley Aquatic Wildlife Conservation Center, Marion, Virginia, (<http://www.dgif.virginia.gov/awcc/>)

Any other contacts and participations at seminars, workshops and scientific meetings are highlighted in annex 49.



Figure 37: Exchange with the freshwater mussel lab at the Genoa national fish hatchery, USA

5.1.22.3 Time schedule

| F2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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5.1.22.4 Indicators

| Deliverables / milestones | Deadline | Progress |
|--------------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Participation at the FMCS conference | 30.03.2013 | Participation with an oral presentation and two poster presentations at the FMCS biannual meeting in Lake Gunterville State Park, Alabama, USA 10-14.03.2013. |

5.1.22.5 Technical and / or financial modifications and justifications

No technical or financial modifications were necessary in this action.

5.1.22.6 Problems encountered

No problems encountered

5.1.22.7 Outside LIFE

None.

5.1.22.8 Outlook

The exchange with other projects dealing with mussels will continue.

5.1.23 ACTION F3: PLAN DE CONSERVATION AFTER-LIFE

5.1.23.1 Expected results

A written document with detailed description of ongoing actions after the LIFE project.

5.1.23.2 Activities and outputs

Some of the measures, which were done during the LIFE Unio project, will continue after the project has ended.

The LIFE Unio team was working on an After-LIFE project, which was handed to the national Ministry of the Environment in October 2018. This project will be financed by the national fund "Fonds de l'environnement" over a period of 5 years. The After-LIFE project started on January 1st 2019 and will end at the end of 2023.

For the After-LIFE Resto Unio we chose measures which can be financed by this fund and which are basically linked to the National nature conservation plan and the Natura 2000 managements plans (concerning both catchments Sauer and Our).

The following measures will continue in the After-LIFE Resto Unio-Action plan:

- Cultivation of freshwater mussels *Unio Crassus*
- Mussel monitoring
- River bank strips and riverside vegetation
- Invasive species
- Feierbëch pilot project
- Awareness-raising

More details can be found in the document After LIFE Resto Unio-Action plan in annex 50.

5.1.23.3 Time schedule

| F2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|
| 2012 | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |
| III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II |
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| | realized |

5.1.23.4 Indicators

The After LIFE Resto Unio was approved by the Minister of environment in October 2018. The approval letter can be found in the annex 51.

5.1.23.5 Technical and / or financial modifications and justifications

No modifications had been done for this action.

5.1.23.6 Problems encountered

No problems encountered for this action.

5.1.23.7 Outside LIFE

The After LIFE Resto Unio was officially approved during the LIFE project. The project itself is financed by national fund for environment.

5.1.23.8 Outlook

To make sure that the LIFE Unio project stays successful over a longer period of time, some of the measures will continue for at least another 5 years. Of course, the rearing of the freshwater mussels and its monitoring were essential parts during the LIFE Unio project, reason why these actions will also continue for at least five more years.

The planting of bank strips and riverside vegetation will have a long-term benefit on the water quality itself as well as to species related to freshwater habitats and its riverside vegetation. The stabilisation of the river banks by planting vegetation along the water course will reduce future erosion and also provides a habitat to a variety of different species (insects, birds, fish, etc.). The shading effect induced by the new vegetation will also reduce the warming of the river especially during summer months.

To control invasive species of spreading throughout both catchments, muskrats and crayfish will be trapped to prevent wider distribution. The continuous trapping is the only effective way to obtain a long-term reduction of those two species, which do not only jeopardise freshwater mussels, but also a range of other aquatic species.

The collaboration with farmers in the catchment of the stream Feierbëch will also have a long-term effect on their behaviour towards the use of fertiliser. Those farmers not only labour in the catchment of the Feierbëch, but will adapt their fertilisation also on other lots they own. By doing so, the positive effect will even go beyond the project area.

Awareness-raising for the general public is also essential to guarantee long-lasting effects. By informing people about the challenges we face today with a rising population, a rising consumption of resources and never-ending contamination or degradation of natural resources, a change in every person's attitude towards a more sustainable development will hopefully bring benefits to all of us and most importantly to future generations.

To prevent farmers from removing fence, watering equipment or cattle bridges in lots where C1 measures were done, we signed a convention with every farmer who is currently using the land where fence, waterings or cattle bridges were financed by LIFE Unio. To guarantee long-lasting effects of those measures, farmers are made responsible for the maintenance of the watering places, the cattle bridges and the fence over a period of 10 years, starting with the signing date of the convention. These conventions can be found in the annex 23.

It was not possible to include the actions C3 and D1 in the After LIFE Resto Unio-Action plan. Since we observed very good results concerning the action C3, with fish using the new gravel banks as spawning grounds, we will work on another project which can be handed into the fund “Fonds de l’eau” at the Ministry of the Environment. The surveillance of the water quality is an essential part because it offers vital data about the habitat of *Unio Crassus* itself. This action will also be part of a new project, which should be financed by the national water fund “Fonds de l’eau”. Discussions with the national Ministry are ongoing.

5.1.24 OVERALL TIMETABLE

| | 2012 | | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 |
|----|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|
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| A1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| A2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| A3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| A4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| A5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| B1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| C1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| C2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| C3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| C4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| C5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| D1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 2012 | | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 |
|----|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|
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| D2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| D3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| D4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| D5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| E1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| E2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| E3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| E4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| F1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| F2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| F3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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5.2 Dissemination actions

5.2.1 OBJECTIVES

An important target of LIFE project is the dissemination of information and knowledge to stakeholders, the public and the scientific community.

We were quite successful in informing people about the importance of our natural freshwater resources and the content of the LIFE Resto Unio project.

International water forums, information events and informal meetings informed the stakeholders such as authorities, administration and farmers regularly.

By promoting the LIFE project, we give the public a better understanding of the Natura 2000 network, nature conservation at European, national and local level. One of the biggest problems is the ignorance about this topic. This goal was achieved by being present at the events of Naturpark Our and Uewersauer (every year in August and March), at larger markets and fairs in the region, events of schools and administrations. We gave the possibilities to see insects and animals out of the river Our and Sauer. Binoculars microscopes were available to get a closer look at the insects.

The idea to equip and use the nature 2000 room as classroom as intended in action E2 was realised. However, with the help of outside life activities (sponsoring (HSBC, Rosport) and a leader project) we were able to install a complete classroom with high quality microscopes, stereomicroscopes and other didactical material. The activities offered in the so-called water experience centre are available under www.kalbermillen.lu. In the project time more than 2.000 children, aged between 5 and 18 years could be educated at the water experience centre.

A constant presence in the press through the publications of articles in a large variety of newspapers, magazines, scientific journals, the radio and TV increased the visibility of the project towards different social groups.

A flyer in different languages (German, English and French) was printed and distributed to people concerned by the project such as landowners, land users and administrations. It was also used to inform people visiting us at events and at the Kalbermillen.

The website allowed people interested in the project to follow the development of the project through regular updates in the news section. It was also supposed to serve other projects and administrations, as information source. It will be kept online for at least five years after the end of the project.

The layman report presents a good overview of the project and its goals reached at the end of the project. Additional we produced a movie focusing on the ecosystem services provided the thick-shelled river mussels with German, French, English and Dutch subtitle. This movie is available at: <https://www.youtube.com/watch?v=8DLQ-S-S9-U>.

The two international seminars were a way to disseminate the knowledge, the elaborated methods and experiences made, to the scientific community.

5.2.2 DISSEMINATION: OVERVIEW PER ACTIVITY

View technical part Actions E1 – E4.

5.3 Evaluation of Project Implementation

5.3.1 METHODOLOGY APPLIED

| Action | Methodology | Success | Failure | Results | Cost-efficiency |
|--------|----------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------|---------------------|
| C1 | fences | - Protection of river banks | - Less acceptance of farmers | 1.965 km | € 21.477,86 |
| | watering places | - streams fenced out and access to water - creation of natural river banks | - discussion with farmers | 8 watering places | € 5.759,28 |
| | cattle passages | - increasing of mobility of cattle onsite | - / | 4 cattle passages | € 180,18 |
| | construction of water evacuation grids | - reduce of sediment income - forestry road conservation | - long term action | 63 grids in 5 forestry roads | € 45.207,01 |
| | agro-environmental measures | - extensification of agriculture | - Delay of national funding system | 20 agro-environmental measures and 51 biodiversity contracts | only personal costs |
| | restoration of a river bed | - using the old riverbed - protecting from income of surface water - giving stream more space | - Ruederbaach – riverbed destroyed during forestry road maintenance | In total 520 m in 5 different tributaries | € 3.060,71 |

| | | | | | |
|----|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| C2 | Building of bridges | <ul style="list-style-type: none"> - Reopen of tributaries - Removing more obstacles than promised - On all sites, except the two transformed in late 2018 (Froumicht, Houschterbaach) fish could again be detected upstream from the removed obstacle | - Long term action | 7 bridges and 1 ford | <p>LIFE: €138.673,28</p> <p>Outside LIFE: € 47.993,23</p> |
| C3 | Gravel input | - Installation of more than 2.655 m ² of gravel banks | - Difficulties with Belgium authorities at the beginning | 1.038,51 m ³ gravel (1.869 tons gravel) | € 53.270,94 |
| C4 | Rearing | <ul style="list-style-type: none"> - Able to produce juvenile mussels, which could be released. - Culture methods improved throughout the project runtime | - Survival of produced mussels in some rearing systems still low. Improvement necessary to be able to release more juvenile mussels. | <p>808 tagged mussels release in the river Our</p> <p>1.078 tagged mussels released in the river Sauer</p> <p>882 more Ourmussel and 1237 more Sûremussels produced which can be released in summer 2019</p> | +/- 75 € per mussel |

| | | | | | |
|----|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------|-----|
| C5 | Muskrat – floating trap | - decreasing the predator pressure on <i>Unio crassus</i> . No new empty shell middens observed on both target rivers. | - / | 372 muskrats captured | € 0 |
| | Trapping signal crayfish – per hand and fyke | - decreasing the predator pressure on <i>Unio crassus</i> | - labour intense | 13.733 crayfish captured | € 0 |

5.3.2 RESULTS ACHIEVED

| Task | Foreseen in the proposal | Achieved | Evaluation |
|---------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purchase of land | 8 ha | 14,01 ha | As land purchase belongs to the main mission of n&e HfN, we were able to fall back on a high level of experience in this domain and were able to surpass the goals set in the application. |
| Interventions pour réduire l'apport en sédiment fins | 2 km fence | 2,4 km | The objective was reached. |
| | 5 watering places | 8 watering places | This objective was surpassed. Several systems of watering places were installed – stream fed and pump |
| | 3 cattle passages | 4 cattle passages | The mobility of the cattle is for farmers very important so we build 1 cattle passage more than foreseen. |
| | 60 water evacuation grids | 63 water evacuation grids | The income of fine sediments from forestry roads was minimized with these grids. The streams reduce their turbidity during rain events and less sediment is brought into the river Our and Sauer. |
| | 40 agro-environmental measures (AEM) | 82 AEM | After a delay of more than 3 years we could get in total 82 agreements with farmers. 62 contracts are biodiversity contracts. |
| | Restoration of a riverbed – 500 m | Restoration of several riverbeds – 520 m | The restoration of the riverbeds took place in combination with the removal of the fish obstacles. |
| Transformation d'obstacles à la migration sur les cours d'eau | Removing of 6 obstacles | Removing of 7 obstacles and restoring 1 ford | The removal was done with the help of the AGE and ANF. Therefore, one obstacle could be realized outside LIFE. The success of the removal was checked with electric fishing. At the tributary Schwärzerbaach 3 obstacles were removed and the stream has no fish obstacle anymore. |
| Amélioration du substrat par dépôt de gravier | 1.000 m ³ (100 m ³ gravel per year and river) | 1.038 m ³ (1896 tons) gravel were dumped in | The Belgian authorities gave the permission in the year 2014 to dump the gravel in the river Sauer. In addition, weather conditions caused problems with the dumping. The new gravel built new banks in the river with a total surface of 2.655 m ² . |

| | | | |
|-----------------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Elevage de <i>Unio crassus</i> pour la Grand Région | 200 host fish captured | On average 1.394 host fish caught per year | The primary used host fish in our area is the European minnow (<i>Phoxinus phoxinus</i>). As this is also the most abundant fish species in both target rivers it caused no problems to catch a sufficient number of host fishes. |
| | 100 host fish in cages in the river | On average we transferred 118 host fish / river / year | The transfer of infested host fish into cages installed in the main river was not possible every year. This was due to sometimes high water levels in the main streams. If this is impossible in one year, a higher number of infested fish can also be released. |
| | 100 host fish in the rearing system | On average we used between 714 (Our) and 819 (Sauer) infested fish in the rearing system | A higher number of fishes was used in the mussel collecting installation. This was necessary to get > 5.000 mussels per year per river. With the observed survival rate of +/- 12% this gave us the possibility to produce between 500-1.000 mussels per river per year. |
| | 2.500 juvenile mussels per year | On average 8.200 mussels from the river Our and 17.000 from the river Sauer could be collected | A much higher number of juvenile mussels could be collected per year as mire infested fish were used. Part of these mussels were used to test new rearing systems. |
| | 500-1.000 mussels released after 3 years | 808 Our mussels released in 2018 1078 Sauer mussels released in 2018 | The mussels were kept longer at the rearing facility as floods during the summertime made it difficult to release the mussels. The advantage of the longer stay at the facility was that all mussels had reached a size where they can be tagged. 882 more "Ourmussel" will be released in 2019 and 1.237 more "Sauermussels" will be released in 2019. |

5.3.3 MONITORING OF PROJECT RESULTS

Most of the actions are visible immediately after implementation. But the impact on the fauna and flora is maybe not seen in the first years. The monitoring of the actions is explained in the technical part (D actions).

Measures to reduce the income of fine sediments into surface water

Banks of fenced riverbed changed within one year the vegetation and became more stable. The watering places and passages also protected the riverbanks and gave the opportunity to the farmers to use their meadows in a more sustainable way. The AEM do not show any effect in the first years. These programmes last for at least 5 years and should reduce the amount of nutrient being washed out as most of the AEM measures include no fertilisation or a reduced fertilisation. However even after 5 years, it will be difficult to monitor this effect, as the plots with AEM's are only parts of larger catchment having also plots still practicing more intensive agriculture. Therefore, we intend to continue the Feierbech pilot project as here a lot of data

about the land use, water quality of sources and soil samples are meanwhile available. If the use of fertilizers becomes optimized in this rather small catchment a reduction of nutrients (for instance nitrate) could become visible in the source water samples within the next years.

Removal of fish obstacles

The fish population (mainly trout) respond quite quickly to the reconnection of upstream parts of a stream. The impact of the removal of the fish obstacles was always visible within one year after the removal, as again fish were caught above the transformed obstacles. The evaluation of the latest transformations (late 2018) can be done one year after implementation.

Improvement of the river substratum with dumped gravel

After one or two floods (after one or two years), the gravel was washed downstream from the dumping sites and the creation of new riverbeds was observed. The redox potential in these newly created gravel banks was measured every year and results are discussed in action D4. At the river Sauer, the electric fishing site Esperbesch and the dumping site coincide. In the third year of electric fishing (2017) the number of minnow was much higher at this site compared to the years before. The minnows, using also clean gravel to spawn might have profited from the newly created gravel banks. However, as the minnow population was also higher at the downstream electric fishing site in 2017 this result has to be discussed carefully, as natural fish population can show noticeable fluctuations between years. Nevertheless, the new gravel banks will have a positive effect on the fish population as well as on invertebrate species.

Rearing of *Unio crassus* for the rivers Our and Sauer

The first juvenile mussels were released into the river Our and Sauer in the year 2018. All of them were tagged which makes an evaluation of the growth and survival after several years possible. Most of the released animals had >3 years of age and will start to reproduce within the next two years and help to strengthen the population naturally. As the follow up of the mussel populations is foreseen in the after LIFE programme this can be evaluated within the next years. In addition, the ecosystem services directly provided by the released *Unio crassus* are not negligible. The release of 2.000 mussels per river (2.000 in 2018 and another 2.000 will be released in early summer 2019) will provide a filtration capacity of around 36 million litre per river per year. The increase of the *Unio crassus* population in the river Our and Sauer was one of the most important objectives in this project. Especially the first three years are crucial for the mussel to stay alive. Therefore, the rearing has to continue to support the natural population.

Control of the muskrat in the rivers Our and Sauer

The amount of captured muskrats decreased within the last years but showed also natural population fluctuations. Newly empty shells opened by muskrats were not observed. The trapping seems to be successful but needs to be continued, which is foreseen in the after LIFE. The population of signal crayfish is reduced on sensitive places to avoid high predator pressure on *Unio crassus*. The monitoring and hunting has to go on to keep the pressure on *Unio crassus* small.

5.3.4 EFFECTIVENESS OF THE DISSEMINATION

The dissemination actions can be seen in the technical report (actions E).

In the LIFE Resto Unio dissemination had two main target groups – stakeholders and general public.

5.3.4.1 Stakeholders

In the runtime of the project we built an extensive network with many stakeholders from the project area (e.g. ministry of the environment, administrations (LU, BE, DE), landowner, land user, nature parks, NGO's, schools etc.). More than 200 meeting with different stakeholder took place. This helped to implement and realise the concrete restoration actions under point C, but also helped supporting the D and E actions. This network will also be very helpful for the after LIFE or further projects in this context. A highlight in this context was for sure the visit of SAR Grand Duc Henri at the mill with many stakeholders (e.g. Carole Dieschbourg Minister of the environment) who followed the project from the beginning.

The most important stakeholder are for sure the landowner and land user, mainly farmers as they manage the largest surface in the catchments of Our and Sauer. The 5 information events for the farmers were, with in total 230 participants (on average 46 per event), well attended. Nevertheless, both catchments represent large areas with many more farmers. Discussions with farmers, for instance to convince them to install fences, watering places or cattle passages, can be exhausting but overall we noted a respectful contact with most of the farmers throughout the project. From the leaflet, dealing with the content of the 5 information events for farmer, send to more than 1.600 farms in Luxembourg we have so far no feedback, as the farmers received it in February 2019.

The exchange with stakeholders from the neighbouring countries (Belgium and Germany) during the 4 water forum was very fruitful and contact with many of the participants still exists.

Recreation angler normally had a positive view on the LIFE Resto Unio project, as many of the project action helped promoting the local fish populations. This is also highlighted by the fact, that together with the local angler associations we organised an open public event at the mill of Kalborn in 2017. This within the celebration activities of 25 year LIFE Programme. A similar event is already planned for 2019.

The exchange with the scientific community worked out fine as demonstrated by the two successful international seminars organized within the LIFE Unio project (see also action E4 and F2).

5.3.4.2 Public

We were quite successful in informing the local population about the importance of freshwater habitats and the ecosystem services provided by the mussels.

We participated at 26 information events in the area (Naturparkfest Our, Waasserfest Uewersauer etc.) with an information stand and could inform about 3.800 people. We have been doing this for many years now and regularly get an invitation from the organizer to participate.

Another 4.400 people (2.100 adults & 2.300 school children) were informed during visits at the mill of Kalborn. Especially the new Natura 2000 room and the new school classroom are very attractive. Normally we get around 15 requests from adult groups to visit the mill per year, this without doing any extra publicity. During the normal working hour at the mill, we open the Natura 2000 room for hikers and other visitors who pass by. We also notice regular visits of the room, as we see from comments in our guest book. However, we do not know the exact number of spontaneous visits at the NATURA 2000 room as we have no counting system (we do not plan to install one). For school classes we do a yearly invitation to visit the water

experience centre by sending a flyer to all schools in Luxemburg. This is part of the outside LIFE Leader project.

About once per year we get a demand to present our work on the radio or on TV. This shows us that our dissemination work is effective and that saving endangered animals and conserving our nature for future generation is interesting for the general population.

Although the kick of events for the LIFE Unio project in both catchments were still well attended, we were a little disappointed that only 50 people showed up during the two closing events (25 in each catchment). Even though we distributed an invitation to every household in the municipalities concerned (>10.000) the feedback was low. This low return of interest was however also observed from other organisation arranging similar events. In times of smart phone, internet and other mass media, many information channels exist and appearing at a certain time at a certain location to get information might have become less attractive.

We have to admit that we were not using newer information channels like Facebook, Instagram etc. in this project but only stayed with our website which had good numbers of visit (see also E3). From time to time information's about our project appeared however on the natur & ëmwelt facebook account.

Since August 2018 the LIFE Unio project movie is available at the natur & ëmwelt youtube channel and the Unio website and got 460 visits so far. It was foreseen to produce hardcopies of the movie. But our experience from a former project showed, that this is not necessary and that a larger audience is attained by using online channels.

5.4 Analysis of long-term benefits

5.4.1 ENVIRONMENTAL BENEFITS

5.4.1.1 Direct/ quantitative environmental benefits

In the project, several measures were done to improve the habitat of *Unio crassus* on long-term.

The purchase of land 14,01 ha financed by LIFE and 7,28 ha Outside LIFE gives us the opportunity to manage the land in a more sustainable way on the long-run. Forest plots are replanted with deciduous leaf trees, biodiversity contracts are obligatory for farmers leasing agricultural areas from n&ë.

Fencing, watering places and cattle passages protect the riverbank (see C1) and allow the growth of a natural vegetation, which helps the stream to build up its self-cleaning capacity. The construction of water evacuation grids inhibit the income of high amount of sediment during rainy periods. On the other hand agri-environmental measures such as nitrogen reducing programmes and biodiversity contracts offers other ways to save surface water from pollution with nutrients, fine sediments and pesticides. All these activities help to protect our water resources.

The bridges (C2) built to reopen the tributaries of the rivers Our and Sauer enable fish and other aquatic species to migrate again upstream to the spring area. These benefits become visible within one year.

The dump of gravel (C3) into the rivers Our and Sauer, creating new gravel banks, are very useful for minnow (*Phoxinus phoxinus*) and other species who use gravel in their life cycle (C1).

The *Unio crassus* population in both rivers is supported by juvenile mussels (age 3 years old). Since 2018 we were able to release +/- 1.000 mussels per river. These means an increase of 6,7% for the river Our population and 7,1% for the river Sauer population. These mussels are filtering around 40 litres per day. In the next years, we will be able to calculate the survival rate of these young mussels. These 1.000 mussels per river are also an important factor in the food web of river ecosystems as they make suspended material available for other aquatic organism. The mussels support already existing mussel populations in the river ("No watering –can principle").

The data and knowledge provided from the LIFE Resto Unio team for the elaboration of the two Natura 2000 management's plans has an impact on the management of these sites, especially considering the maintenance of the habitat of *Unio crassus*. The newly founded "Comité de pilotage Natura 2000 Éislek" (signature of the collaboration contract was in October 2018) now has the task to implement the measures listed in the documents written with the help of the LIFE Resto Unio team. Furthermore the Natura 2000 room helps spreading the concept of Natura 2000 among stakeholders and the larger population.

The measure of removing the fish obstacles done in cooperation with AGE and ANF are in line with the national water management plan, national nature protection plan and help to achieve the objectives demanded by the water framework directive. Any other measures done in this project, improving the aquatic habitat and the water quality will help reaching the goals of the water framework directive.

The intense water monitoring programme established within the LIFE unio project helped detecting various sites with income of sewage and wastewater. These information's are very helpful for the AGE and the local wastewater treatment ring to improve or restore the respective sites.

5.4.1.2 Relevance for environmentally significant issues or policy areas

The project objective of restoring the habitats of *Unio crassus* cannot be reached without networking with stakeholders from the neighbour countries having larger part of the river Our and Sauer catchments on their territory. Therefore, we organized two events for each river to increase the exchange between the different administrations of all concerned countries.

Another main topic of the LIFE project was raising public awareness and providing education on nature and conservation. The targets of the EAP (environmental action programme) can only be reached through the appreciation and collaboration of the general public. Through its presence in the media, at fairs and markets and the Natura 2000 room at Kalbermillen the LIFE Resto Unio project reached a large audience.

The agriculture is an important economic factor in the north of Luxembourg. The high living standard in Luxembourg plays an important role in the change of agriculture. Extensive agriculture is no longer lucrative. Therefore, many farmers stopped working and the remaining farmers work more intensively. A good collaboration with the agriculture is necessary to protect our water resources and to keep the water quality on a high level.

During the project time, we were able to work on two important issues:

Pesticides issue:

Together with Greenpeace Luxembourg, natur&ëmwelt made a demand for significant modifications to the national action plan on phytopharmaceutical substances worked out by the Agricultural Ministry see annex 39 submitted with the mid-term report March 2015. The action plan should be the national transposition of "article 4 de la directive 2009/128/CE du Parlement européen et du Conseil du 21 octobre 2009 instaurant un cadre d'action communautaire pour parvenir à une utilisation des pesticides compatible avec le développement durable". A weak point is that there will be pesticide restrictions in the catchment areas used as drinking water source. In all other water dependant zones and Natura 2000 sites, limitations are on a voluntary basis. We are missing a long term reduction of pesticides and a real strategy to avoid water pollution. A press conference was organised on the 10th of October 2014. Since this time no changes in the regulations were done.

We were invited to join the national parliament on the 4th of December 2014 to answer the questions of members of the Commissions of Environment, Agriculture and Petition. A general declaration was given: "the goal is to save biodiversity and the honeybee, important for the national economy, so that the national action plan of phytopharmaceutical substances will be revised". A meeting with the Minister of Agricultural took place on 21th of January 2015. On our question when the plan will finally be revised, the Agricultural Ministry did not want to give a statement. He said that for the moment a Task Force is working on this subject. Greenpeace Luxembourg and natur&ëmwelt insisted that Luxembourg needs a change of paradigm of the agricultural activities. The output of pesticides must be reduced to a minimum in order to protect our natural resources water, soil and biodiversity. So far, we have no update on this issue.

Erosion issue:

In Belgium, wood harvesting is not allowed when weather conditions are bad (too wet, muddy soil) while in Luxembourg this is not the case. This explains why Belgian enterprises are often working during bad conditions in Luxembourg. Their activity often leads to erosion problems in the forest. We heard about a regulation "Règlement sur la voirie rurale et forestière" installed in the municipalities of the Haute-Sauer basin that could help avoiding damage in the forests, as one has to deposit caution money at the municipality before being allowed to harvest the wood. In this case, the forest ranger will be informed when the harvesting starts. We would approve the application of the same system in the river Our catchment. After

a conversation with the local forest ranger and a technician of the municipality of Clervaux we heard that such a project (see Annex 40) has been introduced to the Ministry of Interior Affairs for a long while. With the help of the MDDI we tried to find out what happened to this document and when it could be operational. At the moment we are still waiting for this system to become operational for the river Our catchment.

Weirs and Hydropeaking:

On both streams Our and Sauer, which are transborder streams still some dam exist. On some locations (Stoubach, Alte Mühle, Germany / Dasburg, RellesMühle, Germany/Bigonville, Moulin de Bigonville, Luxembourg) the weir and mills are used to produce hydropower. Although forbidden by law, we often observed at these three sites hydropeaking events, especially during low discharge periods in summer. The water fluctuations from sometimes 20cm or more cause that some riverbank fall dry and thus stress the mussels living in these areas. If these fluctuations continue for days or weeks, this also leads to the death of animals. We pointed the problem out during most piloting committee meetings as well as on the transborder water forums and during exchange with the national, Belgium and German authorities. Letters were send by the German authorities to both mills on the German site and visits took place. It turned out, that especially in the case of the Alte Mühle in Stoubach a cleaning of the weir from woody debris solved the problem. The owner of the Rellesmillen did recently technical transformations at his locations and we need to follow the water gauge below the mill to see if any positive effects take place. The weir at the moulin de bigonville got also transformed as a fish bypass was added in 2017. This work accompanied by the Luxemburgish water administration. We need to follow the situation at this site carefully in the future as well.

In the village Untereisenbach two weirs used to supply mills with water. Within an Interreg project both weirs were almost completely or partly removed and become again passable for fish. The lower weir, which was only partly removed, still supplies the old mill channel with water. Our mussel mapping showed that the old mill channel is populated by *Unio crassus* and *Anodonta anatina* and *Rhodeus amarus*. The old weir seems to inhibit the ice drift in the winter and caused a flooding at a camping site further upstream in the last years. The owner asked the municipality to remove the remains of the second weir and a hydrological study was done by an engineering office to calculate the effect of the removal on the ice drift and water level. The complete removal of the remains of the dam would improve the situation and help to protect camping upstream from flooding due to ice drift. This would however stop the supply of the old mill channel with water and the mussels and European Bitterling would disappear. The LIFE Unio team, participated at meeting from the AGE and the engineering office in September 2018 to find a compromise how the camping site can be protected without abandoning the mill race way. The solution will be to widen the riverbed a little more upstream and to completely remove the remains of the first weir (see also annex 36 of action D3)

5.4.2 LONG TERM BENEFITS AND SUSTAINABILITY

5.4.2.1 Long term / qualitative environmental benefits

The *Unio crassus* population seems to be stable at the river Our but still decreasing in the river Sauer. Therefore, it is very important to support the population further on.

For this purpose, we developed an After LIFE Action plan. The main objectives in this plan are the rearing of the mussels, the monitoring of the population, the trapping of invasive predators, fencing out of the main streams and planting of natural trees next to the riverbanks. The pilot project with the farmers in the catchment area of Feierbech should go on to find the correlation between the good technical practice and the water quality.

Another important part of the After LIFE plan is the ongoing of the public awareness. The environmental education at the mill of Kalborn, the Natura 2000 room, guided tours through the mill, the presence at fairs

and markets and a booklet about freshwater mussels in Luxembourg should offer many possibilities to inform the general public.

The After LIFE plan will carry out the actions C1, C4, C5, D3 and E2 and is financed by the “Fonds pour l’Environnement” of the MDDI and its run time is from January 2019 to December 2023.

The network with the different stakeholders is an important factor for the ongoing of the conservation and restoration measures in the catchment area of the river Our and Sauer. The cooperation with the administration AGE and ANF, the Naturparks Our and Sauer, the waste water syndicate SIDEN, the farmers in the catchment areas and the ministry of the environment will go on and opens new possibilities to optimize the habitat and the water quality.

The catchment area of both rivers is quite big and the threats on *Unio crassus* are still the same – invasive predators, insufficient water and habitat quality. However, with the help of the After LIFE Action plan and the network of stakeholders in the catchment area we will be able to continue our work in the next 5 years.

5.4.2.2 Long term / qualitative economic benefits

The economic benefits are difficult to evaluate because there is no commercial use of the mussels and the rivers. However, in the long-term all implemented measures can reduce social costs. Riverbed restoration, deciduous forest planting buffer strips and more wet areas due to the fencing will improve the water retention in the catchment, which again will buffer and reduce the risk of floods, often causing high economic damage.

During the project time, we removed fish obstacles, we fenced and built watering places. All these measures increase the self-cleaning potential of the small streams in the catchment. These streams are able to bring clean water to the main streams and dilute pollution. The mussels in the rivers filter about 30-40 litres per day. In case of the river Sauer the dilution effect and the filtering mussels can reduce the cost for supplying drinking water. The river Sauer reservoir above Esch-sur-Sûre supply's the largest parts of Luxembourg with drinking water. In case of the water evacuation grids, all these forestry roads can be kept in good condition and be used in long-term without big maintenance costs.

Keeping the streams and rivers in a natural and pristine condition will also attract hikers and many other visitors and therefore have a positive effect on the tourist economy in the area.

5.4.2.3 Long term / qualitative social benefits

“You only protect what you know” - environmental education is one of the most important factor for nature conservation. Therefore the Natura 2000 room provides a lot of information about the Natura 2000 network and the Natura 2000 area in the Our valley. The room is open during the working hours at the mill.

Together with the WEZ (Water Experience Centre) we welcomed about 2.277 pupils. The positive feedbacks and the wishes to come back shows the importance of such location and offers.

The presence on fairs and markets in the region allows a very close contact with the general public and the stakeholders, some of them still having prejudice against our NGO or our work. In June 2017, we organised an event with the local angler organisation from Heinerscheid. About 160 visitors came to the Kalbermillen and some of them visited the mill for the first time. The feedback was very positive. We will repeat this event in June 2019.

The project area is situated in the north of Luxembourg where agriculture is the main actor concerning land use. For the implementation of the concrete actions, we charged local companies to support the regional economy. For fencing, building the watering places and cattle passages we asked CNDS to do the work.

CNDS is a social structure helping socially disadvantaged people to find a way back into the working life. This can happen because the work of these people has a direct impact on biodiversity by conserving and improving nature and environment. This is very important for their self-confidence.

In conclusion, we can say that the mill of Kalborn and our projects are already well known in the region.

5.4.2.4 Continuation of the project actions by the beneficiary or by other stakeholders

The beneficiary n&ë was responsible for the project and its actions and will be responsible for the implementation of the After LIFE Action plan and the continuation of the actions.

The government organised an administrative structure to implement the Natura 2000 management plans. In the north of Luxembourg the COPIL (Comité de pilotage, based in the Naturpark Our) is charged with this task and will carry on measures to improve the quality of the Natura 2000 areas. This structure will give our NGO the possibility to get funding for the implementation of concrete measures in the Natura 2000 area.

The purchase of land is still the main focus of n&ë/HfN and is independent from the After LIFE Action plan. The purchase of land is co-financed for up to 75% by the government, the remaining costs are covered by donations to the foundations.

5.4.3 REPLICABILITY, DEMONSTRATION, TRANSFERABILITY, COOPERATION

The methods and different actions that were effective during the duration of the project will be shared and made available for other environmental managers. This also includes the methods developed at the rearing facility. Actually the LIFE Unio project was, at least to our knowledge, the first project worldwide trying to breed *Unio crassus* in larger numbers.

All these information and experiences are provided on the website and had been presented at numerous national and international seminars (see F2).

During the project run time, we put an emphasis on working in collaboration with local actors, national and international administrations and stakeholders.

The water forums of the river Our and Sauer provided the possibility to meet each other and to exchange the knowledge about different projects in the respective catchment areas. This increased our visibility and might initiate similar projects. We have meanwhile good cooperation with the neighbouring countries that will lead to further projects hopefully (we have already two demands to participate with our knowledge in two new LIFE projects in Belgium).

A constant knowledge exchange was kept with other structure such as the Naturpark Our and Sauer, nature parks in Germany and Belgium and the LIFE projects, UC4LIFE, LIFE Eislek and LIFE Orchis among many others. A cooperation with the COPIL in the north of Luxembourg is scheduled and should promote the knowledge and experiences exchange with other projects.

5.4.4 BEST PRACTICE LESSONS

The beneficiary had experience in rearing of mussels and in the implementation of measures to increase water and habitat quality.

The rearing of *Unio crassus* was operated on this scale at mill of Kalborn for the first time in Europe. The methods implemented in the LIFE Resto Unio project were influenced by the experiences of the LIFE Freshwater pearl mussel project (LIFE 05NAT/L/000116) and the good exchange with many other mussel projects.

The removal of fish obstacles and the building of bridges was an important part and cost intensive. To save time and money the responsible company invented a new system, using a prefabricated concrete bridge, which can be installed fast and with less interferences to the surrounding. The administrations AGE and ANF are interested to implement this system.

On purchased land, we planted new trees in a special way – called qualifier dimension, a method that is implemented in Germany to produce strong leaf trees. The success of this method will be seen in the next years. More information can be found in annex 15 of action B1.

5.4.5 INNOVATION AND DEMONSTRATION VALUE

The rearing methods developed at the Kalbornermillen is unique for *Unio crassus*. The system has already been successfully tested and used with *Unio crassus* by the LIFE “UC for Life” in Sweden. We also demonstrated or showed our methods during the participation on many scientific conferences in Europe and in the USA.

The construction of the bridges with this module system helps saving a lot of money and time and avoids unneeded interferences with the surrounding. The bridges are used as examples for further projects.

5.4.6 LONG TERM INDICATORS OF THE PROJECT SUCCESS

The project’s success in the long term will be evaluated by the status of the target specie *Unio crassus* and the population before and after all these measures. The monitoring continues after the project according to the After LIFE Action Plan.

The state of the water quality of the rivers Our and Sauer and its tributaries provides a second indicator for success concerning the LIFE Resto Unio project.

6 COMMENTS ON THE FINANCIAL REPORT

6.1 Summary of costs incurred

Table 28: Project costs

| SUMMARY OF COSTS INCURRED | | | | |
|---------------------------|-----------------------------------------|-------------------------------------------------------------------|--------------------------------------------|------------------|
| Project Costs Incurred | | | | |
| Cost Category | Budget according to the grant agreement | Budget total 09.2012-28.02.2019 after AMENDMENT signed 28.07.2016 | Costs incurred within the project duration | % of total costs |
| Personnel | € 1.089.312,00 | € 1.176.240,00 | € 1.183.394,21 | 101% |
| Travel | € 38.049,00 | € 38.049,00 | € 26.200,75 | 69% |
| External assistance | € 272.100,00 | € 272.100,00 | € 266.886,84 | 98% |
| | | | | |
| Durable goods - Equipment | € 222.100,00 | € 212.172,00 | € 198.370,84 | 93% |
| Land/rightspurchase/lease | € 81.600,00 | € 81.600,00 | € 88.367,49 | 108% |
| Consumable material | € 31.939,00 | € 31.939,00 | € 29.966,65 | 94% |
| Other direct costs | € 238.413,00 | € 161.413,00 | € 186.694,99 | 116% |
| Overheads | € 83.555,00 | € 83.555,00 | € 83.555,00 | 100% |
| TOTAL | € 2.057.068,00 | € 2.057.068,00 | € 2.063.436,77 | 100% |

Even though the budget has been surpassed by € 6.368,77,- the allowed flexibility of € 30.000 and 10% has been considered in all categories. In the proposal for the prolongation, we took most of the money out of the category “Other direct costs”. The lack of money is compensated by the underspending of the action categories – travel, durable goods and consumables.

Personnel: This category is slightly overspent, but we needed help for finishing the Natura 2000 room, preparing the layman report (writing and layout) and the layout for the flyers for the farmers. Additional we needed support for the land purchase. All this work was done by employees of n&e Hfn.

Travel: This category is underspent because most of the exchange with other projects was done per email or by telephone. At least once a year a member of the team visited an international congress and an oral or poster presentation was given. For several of these events we got an invitation and travel costs were covered by the inviting organisation. Most of the money goes towards fuel consumption of travelling in Luxembourg between the two Natura 2000 areas.

External assistance: The budget is slightly underspent because several measures were cheaper than the budget foreseen in the proposal (e.g. water evacuation grids (action C1), bridges (action C2)). On the other

hand the costs for the movie (action E2) were much higher than initially foreseen. The layout of the layman report (action E2) and the flyer (action E1) was done by our own graphic designer.

Durable goods/Equipment: The category is underspent. All of the foreseen material was bought and categorized. We bought 2 more computers than foreseen (5 persons were working on the project). But we did not need a printer and a copy machine. The overall costs for the 4 PCs and 1 beamer is less than 2 PCs, 1 beamer, 1 printer and 1 copy machine. (5.166,70€ to 5.500,00€). Additionally we bought a muffle furnace to evaluate the collected fine sediments (see D4). Nevertheless we have an underspending of the budget.

Land purchase: We were able to buy with a small overspending more than 14,01 ha (175.13%) instead of 8 ha.

Consumable material: Most of the money, which was foreseen for drink and food, was not spent. The surplus was used for other direct costs.

Other direct costs: The other costs were underestimated after the prolongation proposal. We reduced the budget for the action C4 by 33% and for the action D1 by 47%. The costs for electricity were higher than estimated (about 4.500€/year, water pumps and aeration). The costs for chemicals for the weekly analysis and the study of the pesticides exceeded the budget as well.

6.2 Accounting system

6.2.1 ACCOUNTING SYSTEM

The main accountants department from Fondation Hëllef fir d'Natur is located at our main office in Kockelscheuer, Luxembourg City. They use an analytical accounting system (Software Ciel) and all original invoices are paid and archived there. Each invoice has its own number and is labelled with "8EUUNIO". Copies were kept during the project course in the Heinerscheid's office.

n&e HfN is not subjected to VAT since the beginning of the project.

6.2.2 PROCEDURE OF APPROVING COSTS

Every invoice concerning the LIFE project first gets to our LIFE office located in Heinerscheid. Here the invoice is checked for correctness by the secretary Patricia Heinen (LIFE code on invoice, costs correct). The team member responsible for the expenditure (Alexandra Arendt, Sonja Heumann, Frankie Thielen, Manou Schirtz) is checking if the invoice is eligible, makes the attribution to the relevant action and signs it. The secretary makes the registration into the accounting table using the EC Excel financial template. The original invoice is sent to the main accountants department and a copy is archived at our LIFE office.

6.2.3 TIME RECORDING SYSTEM

The team members record their time spent on the project in the Excel-based timesheets (EC LIFE template) prepared by the secretary Patricia Heinen at the beginning of each year.

We have no registration system. Everybody is responsible for its own time management.

The timesheets are dated and signed by the project coordinator. The timesheet of the project coordinator is signed by the director Gilles Weber, the timesheet of Gilles Weber is signed by the President of n&e HfN Patrick Losch.

6.2.4 INVOICES

For each offer and each invoice, we ask the company to put the LIFE project name and acronym. If not mentioned after several reminders, the project is applying a stamp with the requested information (full LIFE reference).

6.3 Partnership arrangements

There are no associated beneficiaries.

We have partnership agreements with MA and MDDI financing the national part.

Fondation Hëllef fir d'Natur has officially changed its name to natur&ëmwelt-Fondation Hëllef fir d'Natur in 12/2016, but it is always the same organisation.

6.4 Auditor's report/declaration

The auditor's name is "bakertilly", 45 rue des Scillas, L-2529 Howald, Luxemborg, www.bakertillyaudit.lu.

The auditor's report is a separate document provide in annex 59. The report concludes that the financial report of the LIFE Resto Unio gives a correct appreciation of the revenues and expenses of HfN.

6.5 Summary of cost per action

The costs per action are largely in line with the application. Several unforeseen costs and non-substantial budget transfers that took place are explained in the appropriate action below. This did not compromise any of the project's objectives.

Explanation to the cost changes for each action where substantial differences occur compared to the application:

Action A2

- External assistance – Foreseen costs were used for removing fish obstacle and building a bridge (action C2).

Action C2:

- External assistance – overspending for the bridges but there was one more obstacle removed than foreseen. The missing money was taken from A2.

Action C4:

- Equipment – was cheaper than foreseen.
- Consumables – spent more for small material and consumables at the rearing stations (filter material, products for the cell counter etc.).
- Other costs – underestimated after prolongation.

Action D1

- Equipment – the turbidity logger was more expensive than foreseen (7.837,94 € instead auf 5.000 €)
- Consumables - spent more for small material for the laboratory (tips, gloves etc.).
- Other direct costs – the amount of analysed water sample was higher than foreseen therefore more chemicals were needed.

Action D3

- External assistance – the age determination study of the shells was more expensive than foreseen 6.000 € instead of 2.500 €. The costs for this external assistance were underestimated at the beginning.

Action D5

- External assistance – Report about the socio-economic analysis, no costs were foreseen for this report.

Action E2:

- External assistance – overspending for the production of the movie. (20.609,88 € instead of 10.000 €).

Action F2

- Consumables – underspending because less catering costs for “comité de pilotage”.

Table 29 Summary of cost per action

| | Short name of action | 1. Personnel | 2. Travel | 3. Ext Assistance | 4.b. Equipment | 5. Purchase of land | 6. Consumables | 7. Other costs | Total |
|-----|------------------------------------------------------|-----------------------|--------------------|---------------------|---------------------|---------------------|--------------------|---------------------|-----------------------|
| A1: | Localization | 19.316,78 € | 233,42 € | 0,00 € | 0,00 € | 0,00 € | 543,56 € | 0,00 € | 20.093,76 € |
| A2: | Planning | 24.339,14 € | 311,43 € | 0,00 € | 0,00 € | 0,00 € | 102,89 € | 0,00 € | 24.753,46 € |
| A3: | Water quality | 9.368,64 € | 416,50 € | 384,00 € | 32.203,18 € | 0,00 € | 0,00 € | 0,00 € | 42.372,32 € |
| A4: | Rearing method | 17.578,27 € | 5.837,77 € | 92,46 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 23.508,50 € |
| A5: | Elaboration Natura 2000 management plans | 19.316,78 € | 233,42 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 19.550,20 € |
| B1: | Land purchase | 17.385,10 € | 233,42 € | 0,00 € | 0,00 € | 88.367,49 € | 0,00 € | 0,00 € | 105.986,02 € |
| C1: | Reduce sediment | 40.951,57 € | 466,85 € | 46.935,44 € | 35.333,61 € | 0,00 € | 0,00 € | 0,00 € | 123.687,47 € |
| C2: | Removing fish obstacle | 10.817,40 € | 116,86 € | 136.931,67 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 147.865,93 € |
| C3: | Gravel input | 7.340,38 € | 77,71 € | 13.900,07 € | 0,00 € | 0,00 € | 0,00 € | 39.370,87 € | 60.689,03 € |
| C4: | Breeding <i>Unio crassus</i> for the "Grande Région" | 334.083,70 € | 2.416,34 € | 0,00 € | 98.229,44 € | 0,00 € | 11.243,09 € | 80.695,39 € | 526.667,96 € |
| C5: | Capturing of muskrats | 9.272,05 € | 77,71 € | 0,00 € | 0,00 € | 0,00 € | 980,50 € | 0,00 € | 10.330,27 € |
| D1: | Water quality | 22.697,22 € | 253,00 € | 0,00 € | 8.022,43 € | 0,00 € | 6.574,96 € | 60.803,74 € | 98.351,34 € |
| D2: | Host fish monitoring | 26.319,11 € | 330,71 € | 0,00 € | 0,00 € | 0,00 € | 717,03 € | 0,00 € | 27.366,85 € |
| D3: | <i>Unio crassus</i> monitoring | 30.810,26 € | 359,92 € | 6.000,00 € | 2.532,19 € | 0,00 € | 705,89 € | 0,00 € | 40.408,27 € |
| D4: | Monitoring and evaluation | 22.938,68 € | 229,04 € | 5.205,00 € | 3.106,00 € | 0,00 € | 0,00 € | 0,00 € | 31.478,72 € |
| D5: | Effect on the ecosystems | 13.521,75 € | 194,86 € | 2.925,00 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 16.641,61 € |
| E1: | Information and sensitization | 29.361,50 € | 389,14 € | 568,62 € | 0,00 € | 0,00 € | 4.550,00 € | 0,00 € | 34.869,26 € |
| E2: | Sensibilization of the general public | 64.952,67 € | 740,01 € | 40.600,83 € | 18.708,46 € | 0,00 € | 3.960,70 € | 0,00 € | 128.962,67 € |
| E3: | Design of web site | 15.839,76 € | 155,71 € | 7.552,25 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 23.547,72 € |
| E4: | Organization of conferences | 16.998,77 € | 233,42 € | - € | 0,00 € | 0,00 € | 0,00 € | 5.824,99 € | 23.057,18 € |
| F1: | Project management | 352.048,31 € | 893,75 € | 5.791,50 € | 235,53 € | 0,00 € | 426,57 € | 0,00 € | 359.395,65 € |
| F2: | Knowledge exchange: | 78.136,37 € | 11.999,74 € | - € | 0,00 € | 0,00 € | 161,46 € | 0,00 € | 90.297,57 € |
| F3: | After-LIFE conservation Plan | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € | 0,00 € |
| | Total | 1.183.394,21 € | 26.200,75 € | 266.886,84 € | 198.370,84 € | 88.367,49 € | 29.966,65 € | 186.694,99 € | 2.063.436,77 € |

7 ANNEXES

7.1 Administrative annexes

| Action/ Chapter | Annex | Title |
|-----------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Annex 1 | Attestation VAT n&e HfN |
| | Annex 2 | Circulaire interne relative aux marchés publics |
| | Annex 3 | Statue n&e HfN |
| | Annex 4 | Answer amendment request |
| | Annex 5 | Grant agreement MA, MDDI and MIGR |
| | Annex 6 | Response to all letters from EC & external office |
| | Annexes from former reports | <ul style="list-style-type: none"> - Annex_12_VAT_document (submitted with inception report February 2013) - Annex_13_OUTPUTS (submitted with inception report February 2013) - Annex_39_long-term_benefits_1 (submitted with mid-term report March 2015) - Annex_40_long_term_benefits_2 (submitted with mid-term report March 2015) |

7.2 Technical annexes

| Action/ Chapter | Annex | Title |
|------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action A1 | | |
| 5.1.1 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_1_erosion_mapping (submitted with inception report February 2013) |
| Action A2 | | |
| 5.1.2 | Annex 7 | Restoration measure plan 2014 |
| 5.1.2 | Annex 8 | Restoration measure plan 2019 |
| 5.1.2 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_1_priority_list_erosion (submitted with progress report I February 2014) - Annex_1_restoration_measure_plan (submitted with mid-term report March 2015) - Annex_1_restoration_measure_plan (submitted with progress report IV March 2018) - Annex_2_Authorisations (submitted with progress report I February 2014) |
| Action A3 | | |
| 5.1.3 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_2_report_water (submitted with mid-term report March 2015) - Annex_3_report_pre_restoration (submitted with mid-term report March 2015) - Annex_2_water_sampling_points (submitted with inception report February 2013) |
| Action A4 | | |
| 5.1.4 | Annex 9 | Permissions to handle <i>Unio crassus</i> |

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| 5.1.4 | Annex 10 | Rearing protocol for <i>Unio crassus</i> (German) |
| 5.1.4 | Annex 11 | Rearing protocol for <i>Unio crassus</i> (English) |
| 5.1.4 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_1_Rearing_Protocol_Unio_crassus_English (submitted with progress report III March 2017) - Annex_2_authorisation (submitted with progress report IV March 2018) - Annex_3_UC_rearing (submitted with inception report February 2013) - Annex_4_authorisation (submitted with mid-term report March 2015) - Annex_4_authorisation (submitted with progress report I February 2014) - Annex_5_rearing_method (submitted with mid-term report March 2015) |
| Action A5 | | |
| 5.1.5 | Annex 12 | Arrêté ministériel / plan de gestion NATURA 2000 Our |
| 5.1.5 | Annex 13 | Arrêté ministériel / plan de gestion NATURA 2000 Sauer |
| 5.1.5 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_1_management_plan_Our_Sauer_draft (submitted with progress report II March 2016) - Annex_2_PlandeGestion_Natura2000_Our_final (submitted with progress report III March 2017) - Annex_3_PlandeGestion_Natura2000_Sure_final (submitted with progress report III March 2017) - Annex_5_Finance_letter_offer (submitted with progress report I February 2014) - Annex_6_offer_anf (submitted with mid-term report March 2015) - Annex_7_response_anf (submitted with mid-term report March 2015) |
| Action B1 | | |
| 5.1.6 | Annex 14 | Land purchase with overview maps |
| 5.1.6 | Annex 15 | Measures undertaken on purchased land |
| 5.1.6 | Annex 16 | Land purchase with detailed map |
| 5.1.6 | Annex 17 | Notary acts of land purchased |
| 5.1.6 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_2_land_purchase_QD_concept (submitted with progress II report March 2016) - Annex_3_land_purchase (submitted with progress report IV March 2018) - Annex_4_land_purchase (submitted with progress report III March 2017) - Annex_4_notarial_act_photos (submitted with inception report February 2013) - Annex_6_acquisitions_2013 (submitted with progress report I February 2014) - Annex_8_notarial_act_photos (submitted with mid-term report March 2015) |
| Action C1 | | |
| 5.1.7 | Annex 18 | Anti-erosion and Agro environmental measures (AEM) |
| 5.1.7 | Annex 19 | Agro environmental measures - contracts |
| 5.1.7 | Annex 20 | Agro environmental measures – supporting letter ANF |

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| 5.1.7 | Annex 21 | Pilot project Feierbech |
| 5.1.7 | Annex 22 | Letter ANF about Hengischerbaach |
| 5.1.7 | Annex 23 | Conventions with the farmers |
| 5.1.7 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_3_project_feierbesch (submitted with progress report II March 2016) - Annex_4_agro_environmental_measures (submitted with progress report IV March 2018) - Annex_5_demonstration_feierbech (submitted with progress report IV March 2018) - Annex_5_project_feierbesch (submitted with progress report III March 2017) - Annex_6_restoration_feierbesch (submitted with progress report III March 2017) - Annex_7_fencing_treasbech (submitted with progress report III March 2017) - Annex_9_letter_farmers (submitted with mid-term report March 2015) - Annex_10_offer_folkesbour (submitted with mid-term report March 2015) - Annex_11_biodiversity_contract (submitted with mid-term report March 2015) - Annex_12_invitation_piloting_project (submitted with mid-term report March 2015) |
| Action C2 | | |
| 5.1.8 | Annex 24 | Fish migration obstacles |
| 5.1.8 | Annex 25 | Authorisations for fish migration obstacles |
| 5.1.8 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_4_ford_restoration_Syrbbach (submitted with progress report II March 2016) - Annex_6_migration_obstacle_2017 (submitted with progress report IV March 2018) - Annex_7_priority_list (submitted with progress report I February 2014) - Annex_8_removal_tube_schwaerzerbaach (submitted with progress report III March 2017) - Annex_13_plan_schwaerzerbaach (submitted with mid-term report March 2015) - Annex_14_Authorisation_schwaerzerbaach (submitted with mid-term report March 2015) |
| Action C3 | | |
| 5.1.9 | Annex 26 | Gravel dumping and gravel banks |
| 5.1.9 | Annex 27 | Authorisations for the gravel dumping |
| 5.1.9 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_5_Erlaubniss_Our_D (submitted with inception report February 2013) - Annex_7_gravel_banks (submitted with progress report IV March 2018) - Annex_15_maps_sites (submitted with mid-term report March 2015) - Annex_16_authorisation_belgium (submitted with mid-term report March 2015) |
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| 5.1.10 | Annex 28 | Release of cultured <i>Unio crassus</i> in the river Our and Sauer |
| 5.1.10 | Annexes from former reports | - Annex_17_list_durable_goods (submitted with mid-term report March 2015) |
| Action C5 | | |
| 5.1.11 | Annex 29 | Authorisations for the muskrat and crayfish predation |
| 5.1.11 | Annex 30 | Master thesis Elisabeth Kirsch (Predatory Impact Of Signal Crayfish On River Mussel) |
| 5.1.11 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_5_muskrat_PI (submitted with progress report II March 2016) - Annex_8_muskrat_trapping_2013 (submitted with progress report I February 2014) - Annex_18_detail_muskrat_trapping (submitted with mid-term report March 2015) - Annex_19_bachelor_thesis (submitted with mid-term report March 2015) |
| Action D1 | | |
| 5.1.12 | Annex 31 | Pesticide Study from the LIST |
| 5.1.12 | Annex 32 | Water quality report 2018 |
| 5.1.12 | Annex 33 | Water quality report 2013 - 2018 |
| 5.1.12 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_3_water_results (submitted with progress report I February 2014) - Annex_6_first_measurments (submitted with inception report February 2013) - Annex_6_water_quality_data (submitted with progress report II March 2016) - Annex_8_water_quality_data (submitted with progress report IV March 2018) - Annex_9_spring_sampling (submitted with progress report I February 2014) - Annex_9_water_quality_data (submitted with progress report III March 2017) - Annex_10_hydro_peaking (submitted with progress report III March 2017) - Annex_20_sampling_points_maps (submitted with mid-term report March 2015) |
| Action D2 | | |
| 5.1.13 | Annex 34 | Fish monitoring in the river Our and Sauer and their tributaries |
| 5.1.13 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_7_authorisation_e_fish (submitted with progress report II March 2016) - Annex_10_authorisation_e_fish (submitted with progress report I February 2014) - Annex_11_authorisation_e_fish (submitted with progress report III March 2017) - Annex_21_authorisation_e_fish (submitted with mid-term report March 2015) |
| Action D3 | | |
| 5.1.14 | Annex 35 | <i>Unio crassus</i> monitoring report |
| 5.1.14 | Annex 36 | Report about mussel population in the old mill raceway of Untereisenbach |

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| 5.1.14 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_9_sediment_anaysis_2017 (submitted with progress report IV March 2018) - Annex_11_offer_dunca (submitted with progress report I February 2014) - Annex_12_monitoring_Uc (submitted with progress report I February 2014) - Annex_12_sediment_analysis (submitted with progress report III March 2017) - Annex_22_report_age_Uc (submitted with mid-term report March 2015) - Annex_23_monitoring_Uc_Our_Sauer (submitted with mid-term report March 2015) - Annex_24_master_thesis (submitted with mid-term report March 2015) |
| Action D4 | | |
| 5.1.15 | Annex 37 | Impact evaluation report |
| 5.1.15 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_8_monitoring_impact (submitted with progress report II March 2016) - Annex_10_monitoring_impact (submitted with progress report IV March 2018) - Annex_13_monitoring_impact (submitted with progress report III March 2017) |
| Action D5 | | |
| 5.1.16 | Annex 38 | Ecosystem services & socio economic impact study LIST |
| 5.1.16 | Annex 39 | Email costs for ecosystem services & socio economic impact study LIST |
| 5.1.16 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_14_offer_working_plan (submitted with progress report III March 2017) |
| Action E1 | | |
| 5.1.17 | Annex 40 | Raising awareness among the stakeholder |
| 5.1.17 | Annex 41 | Information leaflet for farmers |
| 5.1.17 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_7_PP_presentation (submitted with inception report February 2013) - Annex_9_stakeholder_farmers (submitted with progress report II March 2016) - Annex_10_letter_AGE (submitted with progress report II March 2016) - Annex_11_stakeholder_meetings (submitted with progress report IV March 2018) - Annex_12_water_forum_Our_2 (submitted with progress report IV March 2018) - Annex_13_event_farmer_4 (submitted with progress report IV March 2018) - Annex_13_invitation_letter (submitted with progress report I February 2014) - Annex_14_event_farmer_5 (submitted with progress report IV March 2018) - Annex_14_stakeholder_meetings (submitted with progress report I February 2014) |

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| | | <ul style="list-style-type: none"> - Annex_15_invitation_event_farmer_1 (submitted with progress report I February 2014) - Annex_15_stakeholder_meetings (submitted with progress report III March 2017) - Annex_25_stakeholder_contacts (submitted with mid-term report March 2015) - Annex_26_invitation_event_farmers_3 (submitted with mid-term report March 2015) - Annex_27_water_forum_1_Our (submitted with mid-term report March 2015) - Annex_28_meeting_minister (submitted with mid-term report March 2015) - Annex_29_water_forum_1_sauer (submitted with mid-term report March 2015) - Annex_30_invitation_event_farmers_2 (submitted with mid-term report March 2015) |
| Action E2 | | |
| 5.1.18 | Annex 42 | Public awareness & visits at the mill |
| 5.1.18 | Annex 43 | Kick off and closing events |
| 5.1.18 | Annex 44 | Project flyer DE/EN/FR |
| 5.1.18 | Annex 45 | Indoor outdoor information and exhibition boards |
| 5.1.18 | Annex 46 | Layman report DE/EN/FR |
| 5.1.18 | Annex 47 | Presence in press and press releases |
| 5.1.18 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_8_Exhibition_press (submitted with inception report February 2013) - Annex_11_visits_press (submitted with progress report II March 2016) - Annex_12_letter_SEO (submitted with progress report II March 2016) - Annex_15_visits_mill_2017 (submitted with progress report IV March 2018) - Annex_16_press_release (submitted with progress report IV March 2018) - Annex_16_visit_mills_2016 (submitted with progress report III March 2017) - Annex_16_visits_mill_2013 (submitted with progress report I February 2014) - Annex_17_press_release (submitted with progress report I February 2014) - Annex_17_press_release (submitted with progress report III March 2017) - Annex_18_draft_flyer (submitted with progress report I February 2014) - Annex_18_notice_board_draft (submitted with progress report III March 2017) - Annex_19_overview_natura_2000 (submitted with progress report III March 2017) |

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| | | <ul style="list-style-type: none"> - Annex_31_visit_mill_2014 (submitted with mid-term report March 2015) - Annex_32_press_release (submitted with mid-term report March 2015) - Annex_33_Fleyer_EN_DE_FR (submitted with mid-term report March 2015) |
| Action E3 | | |
| 5.1.19 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_9_Homepage (submitted with inception report February 2013) |
| Action E4 | | |
| 5.1.20 | Annex 48 | International seminars |
| 5.1.20 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_17_announcement_seminar_2 (submitted with progress report IV March 2018) - Annex_34_announcement_seminar_1 (submitted with mid-term report March 2015) - Annex_35_poster_seminar_1 (submitted with mid-term report March 2015) |
| Action F1 | | |
| 5.1.21 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_10_presentation_grant_agreement (submitted with inception report February 2013) - Annex_13_comite_pilotage_4 (submitted with progress report II March 2016) - Annex_18_comite_pilotage_6 (submitted with progress report IV March 2018) - Annex_19_2_comite_pilotage (submitted with progress report I February 2014) - Annex_20_comite_pilotage_5 (submitted with progress report III March 2017) - Annex_20_grant_agreement_MIGR (submitted with progress report I February 2014) - Annex_36_comite_pilotage_3 (submitted with mid-term report March 2015) - Annex_37_grant_agreement_MA_MDDI_MIGR (submitted with mid-term report March 2015) |
| Action F2 | | |
| 5.1.22 | Annex 49 | Scientific exchange report |
| 5.1.22 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_11_poster (submitted with inception report February 2013) - Annex_14_visit_projects_stream_and_river (submitted with progress report II March 2016) - Annex_19_FMCS_Cleveland_permission_PP (submitted with progress report IV March 2018) - Annex_21_poster_alabama (submitted with progress report I February 2014) - Annex_21_presentation_sweden (submitted with progress report III March 2017) - Annex_38_interlife_BE_NL_FR_DE_LU (submitted with mid-term report March 2015) |
| Action F3 | | |
| 5.1.23 | Annex 50 | After life action plan EN/DE |

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| 5.1.23 | Annex 51 | After life action plan convention with MDDI |
| 5.1.23 | Annexes from former reports | / |

7.3 Dissemination annexes

7.3.1 LAYMAN'S REPORT

The Layman's report in three languages (German, English and French) can be found in annex 46.

7.3.2 AFTER-LIFE COMMUNICATION PLAN

The loss of biodiversity continues, both internationally and within the Luxembourg. Various ecosystems are in a critical state, and habitats are suffering different forms of degradation: because of agricultural changes, hydromorphological alterations to surface water bodies (e.g. dams and weirs; irregular flow patterns), sewage plant contamination and water source pollution. We view this After-LIFE action plan as an essential step towards ensuring the sustainability of our water bodies.

A wide range of measures regarding *Unio Crassus* habitats were taken during the LIFE Unio project (LIFE11NAT/LU/857). The aim of this "After LIFE Action plan" is to keep these measures going and to build on them, with a view to achieving the targets set out in the national environmental protection plan (PNPN 2017-2021), the European Water Framework Directive and the Natura 2000 management plans, and the "Strahlwirkungskonzept" for Luxembourg's various water bodies.

To ensure follow-up in both river catchments (the Our and the Sauer) the After-LIFE action plan covers a period of five years (2019-2024). It is funded and was approved on October 2018 by our national Ministry of Environment.

Habitat amelioration has a positive impact not just on the thick shelled river mussel *Unio crassus*, but also on a wide range of other species, like the orange-spotted emerald dragonfly, brook lamprey, bullhead, kingfisher, dipper, osprey, common sandpiper, otter, beaver, goosander, grey wagtail, great crested grebe and black stork. Biodiversity in general is the winner. There are various ways of improving the ecological and chemical status of our watercourses. These include cattle fencing, lower-input farming, and riverbank protection programmes. We also hope to build on the success of the recent project to stabilise the freshwater mussel population and make it sustainable.

The After-LIFE action plan covers the following aspects:

- continuation of mussel cultivation
- mussel monitoring
- riverbank strips and planting in the Our and Sauer catchments
- eradication of invasive species (muskrat and signal crayfish)
- pilot project in the Feierbëch stream catchment
- Awareness-raising

The mussel breeding station is essential to strengthen the populations in both rivers. Also the monitoring of the mussels is essential to further understand the evolution of this species. The planting of riverbank strips will have long-lasting positive effects on both watercourses and its related species. Also the work with our national forestry administration (ANF) is ongoing to fight against invasive species. An exchange of knowledge about crayfish and muskrat hot spots is ongoing between ANF and natur&ëmwelt Fondation Hëllef fir d'Natur.

By inciting farmers to adapt their fertilising techniques, we will continue to take soil samples and show and explain the results to the farmers in the catchment of the Feierbëch. Those discussions will surely go beyond this small catchment and might incite also more farmers to adapt their fertilising in a way that less of the nutrients which they put on their fields will be lost.

The public awareness plays an important role in the national environmental protection plan (PNPN 2017-2021). Therefore, awareness-raising still plays an essential role, because only the things which are known can be protected. Our Natura 2000 exposition room is well visited, mostly by hikers crossing the Kalborn Mill. In addition to our exposition room, we also teach school classes and other private groups about the importance of freshwater ecosystems and other topics related to natural protection, depending on the age and interests of the visitors.

The After LIFE can be found in annex 50.

7.3.3 OTHER DISSEMINATION ANNEXES

| Action A4 | | |
|-----------|----------|----------------------------------------------------|
| A4 | Annex 10 | Rearing protocol for <i>Unio crassus</i> (German) |
| A4 | Annex 11 | Rearing protocol for <i>Unio crassus</i> (English) |

| Action E1 | | |
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| E1 | Annex 41 | Information leaflet for farmers |

| Action E2 | | |
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| E2 | Annex 42 | Public awareness & visits at the mill |
| E2 | Annex 43 | Kick off and closing events |
| E2 | Annex 44 | Project flyer DE/EN/FR |
| E2 | Annex 45 | Indoor outdoor information and exhibition boards |
| E2 | Annex 46 | Layman report DE/EN/FR |
| E2 | Annex 47 | Presence in press and press releases |
| E2 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_8_Exhibition_press (submitted with inception report February 2013) - Annex_11_visits_press (submitted with progress report II March 2016) - Annex_12_letter_SEO (submitted with progress report II March 2016) - Annex_15_visits_mill_2017 (submitted with progress report IV March 2018) - Annex_16_press_release (submitted with progress report IV March 2018) - Annex_16_visit_mills_2016 (submitted with progress report III March 2017) - Annex_16_visits_mill_2013 (submitted with progress report I February 2014) - Annex_17_press_release (submitted with progress report I February 2014) - Annex_17_press_release (submitted with progress report III March 2017) - Annex_18_draft_flyer (submitted with progress report I February 2014) - Annex_18_notice_board_draft (submitted with progress report III March 2017) - Annex_19_overview_natura_2000 (submitted with progress report III March 2017) |

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| | | <ul style="list-style-type: none"> - Annex_31_visit_mill_2014 (submitted with mid-term report March 2015) - Annex_32_press_release (submitted with mid-term report March 2015) - Annex_33_Fleyer_EN_DE_FR (submitted with mid-term report March 2015) |
| Action E3 | | |
| E3 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_9_Homepage (submitted with inception report February 2013) - |
| Action E4 | | |
| E4 | Annex 48 | International seminars |
| E4 | Annexes from former reports | <ul style="list-style-type: none"> - Annex_17_announcement_seminar_2 (submitted with progress report IV March 2018) - Annex_34_announcement_seminar_1 (submitted with mid-term report March 2015) - Annex_35_poster_seminar_1 (submitted with mid-term report March 2015) |

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| Action E2 | | |
| E2 | See movie folder | Movie about the LIFE Unio project with DE/EN/FR and NL subtitle (in electronic format) |

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| Overall project | | |
| Overall project | See photo folder | Photos from the project sorted by action (in electronic format) |

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| Overall project | | |
| Overall project | See presentation folder | PowerPoint presentation highlighting the main action and results of the project (in electronic format) |

| Overall project | | |
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| Overall project | See shapefiles folder | Shapefiles of the respective actions (in electronic format) |

7.4 Final table of indicators

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| Table of indicators | Annex 52 | LIFE + Nature outcomes indicators 2019 |
| Table of indicators | Annexes from former reports | LIFE + Nature outcomes indicators 2013 |

8 FINANCIAL REPORT AND ANNEXES

| Financial report | | |
|---------------------|----------|--------------------------------------------------------------------------------|
| Financial Annex | Annex 53 | "Standard payment request and Beneficiary's Certificate" |
| Financial Annex | Annex 54 | "Beneficiary's Certificate for Nature Projects" |
| Financial Annex | Annex 55 | "Financial Statement of the Individual Beneficiary" |
| Financial report | Annex 56 | Printed excel sheets |
| Supporting document | Annex 57 | Sonja Heumann – contract printed, timesheets and payslips in electronic format |
| Supporting document | Annex 58 | Leo Klein – contract printed, timesheets and payslips in electronic format |
| Auditors report | Annex 59 | Audit "Bakertilly" |