Fondation
Hëllef fir d'Natur

LIFE05 NAT/L/000116

Restauration des populations de moules perlières en Ardennes

Technical Report II: Action D5 Control and survey of the host fish population

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LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Intérieur
et à la Grande Région

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère du Développement durable
et des Infrastructures
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natur musée

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1. Introduction

The Fresh Water Pearl Mussel *Margaritifera margaritifera* is a dioecius species and has a unique and complex life cycle. The male release their sperm in late June into the water to inseminate the females. The larvae or glochidia develop in a pouch on the gill of the female mussel. After a period of a few weeks and depending on the water temperature, the glochidia are released into the water. The glochidia have to encounter a suitable fish host where they fix themselves on the host's gill filaments (Hastie & Young, 2003). In European rivers the only suitable hosts known are the Atlantic Salmon (*Salmo salar*) and Brown Trout (*Salmo trutta fario*) (Hastie & Young, 2001).
Throughout Europe a dramatic decline in Freshwater Pearl Mussel is observed (Ziuganov *et al.*, 1994). In most countries population are over-aged and are, without conservation measures, no longer viable (reproducing). The major threats discussed are industrial and agricultural pollution, habitat degradation due to river engineering as well as low densities of fish hosts.
The only remaining population of Fresh Water Pearl Mussel in Luxembourg is located in the northern part of the country in the low mountain area called Ardennes. Here in the border river Our, a typical nutrient-poor low mountain river the last old individuals of *M. margaritifera* can be found. As elsewhere in Europe the young age classes are missing and the population is about to become extinct. Among many reasons also present in this system is a low host fish density during the last decades which may be partly responsible for the decline.

This report presents the results of fish population monitoring by the LIFE group in the river Our from 2008 to 2010 and also in the associated tributaries during 2008. This technical report follows from the first results of this monitoring programme which was published as "Technical Report: Action D5 of the Life Project (LIFE 05 NAT / L / 00116) in 2007. The ichthyofauna in the tributaries was sampled by electro-fishing in order to ascertain a population dynamic of the fish species present. This allows the progress of certain conservation actions carried out to be measured relative to the population of fish in each stream.

2. Materials and Methodology

Between the 27th of October and the 20th of December 2008 eleven tributaries from the river Our located in the project area were sampled by electro-fishing. The results of annual sampling in the river Our from 2008 to 2010 is also presented.

The electro-fishing in all streams, belonging to the epirhithral, was conducted by wading as the depth was below 50 cm and the width was less than 3 metres in all streams. According to (Haunschmid *et al.,* 2006) one anode was used and if possible in every stream three stretches of 50 metres in length were analysed covering the whole width of the stream. The electro-fishing instrument was an ELT 62II GI –GC V135 carried as a backpack.

All fish caught were transferred to a plastic tank containing river water and determined visually to species level. The individuals were measured (total length) to the nearest mm and weighed to the nearest gram. Subsequently all fish were released into the same stretch where they had been caught. With the data collected the biomass of fish per hectare of catchment as well as the number of individuals per hectare was calculated. The distribution of Brown Trout into size classes was done according to Bagenal & Tesch, (1978).

In most streams the pH, electric conductivity and water temperature was measured with a hand-held measuring device (WTW-350i).

In the following section the results are presented starting with the Reibaach located in the north of the project area close to the Belgian border (see Figure 1).

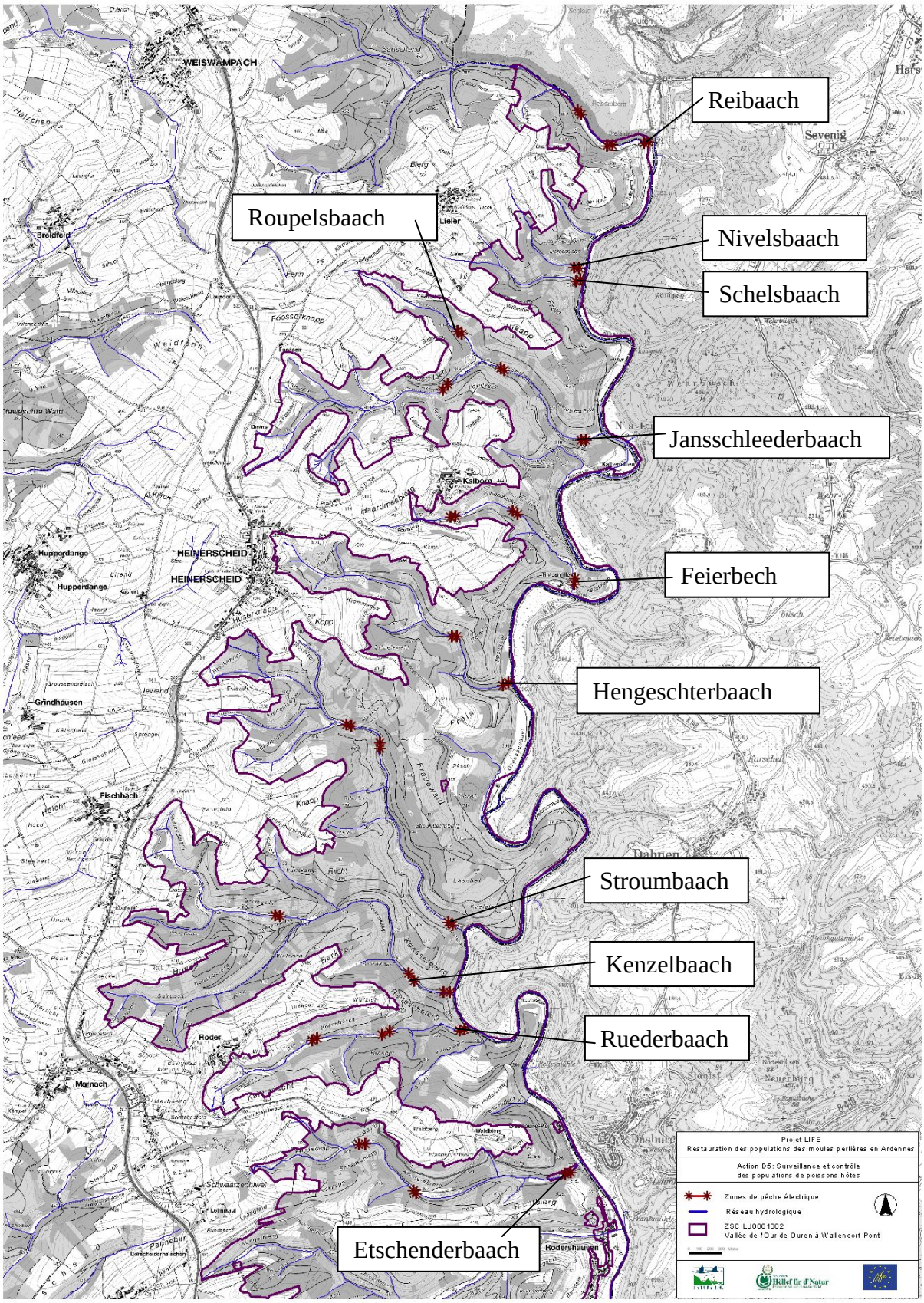

Figure 1 Location of the streams with electro-fishing actions in the project area.

3. Results

3.1. Reibaach

Date of fishing:	27/10/2008		
Zone:	Epirithral		
Number of stretches:	3 (I/1-I/3, location see Figure 2)		
pH:	Stretch 1: 7.55	Stretch 2: 7.59	Stretch 3: 7.77
Conductivity:	Stretch 1: 171.6 µS/cm	Stretch 2: 175.8 µS/cm	Stretch 3: 176 µS/cm
Temperature:	Stretch 1: 9.6˚C	Stretch 2: 9˚C	Stretch 3: 8.9˚C
Oxygen level (mg/l)	Stretch 1: 10.76 mg/l	Stretch 2: 10.57 mg/l	Stretch 3: 10.39 mg/l
Oxygen saturation (%)	Stretch 1: 98.2%	Stretch 2: 95.9%	Stretch 3: 94.8%

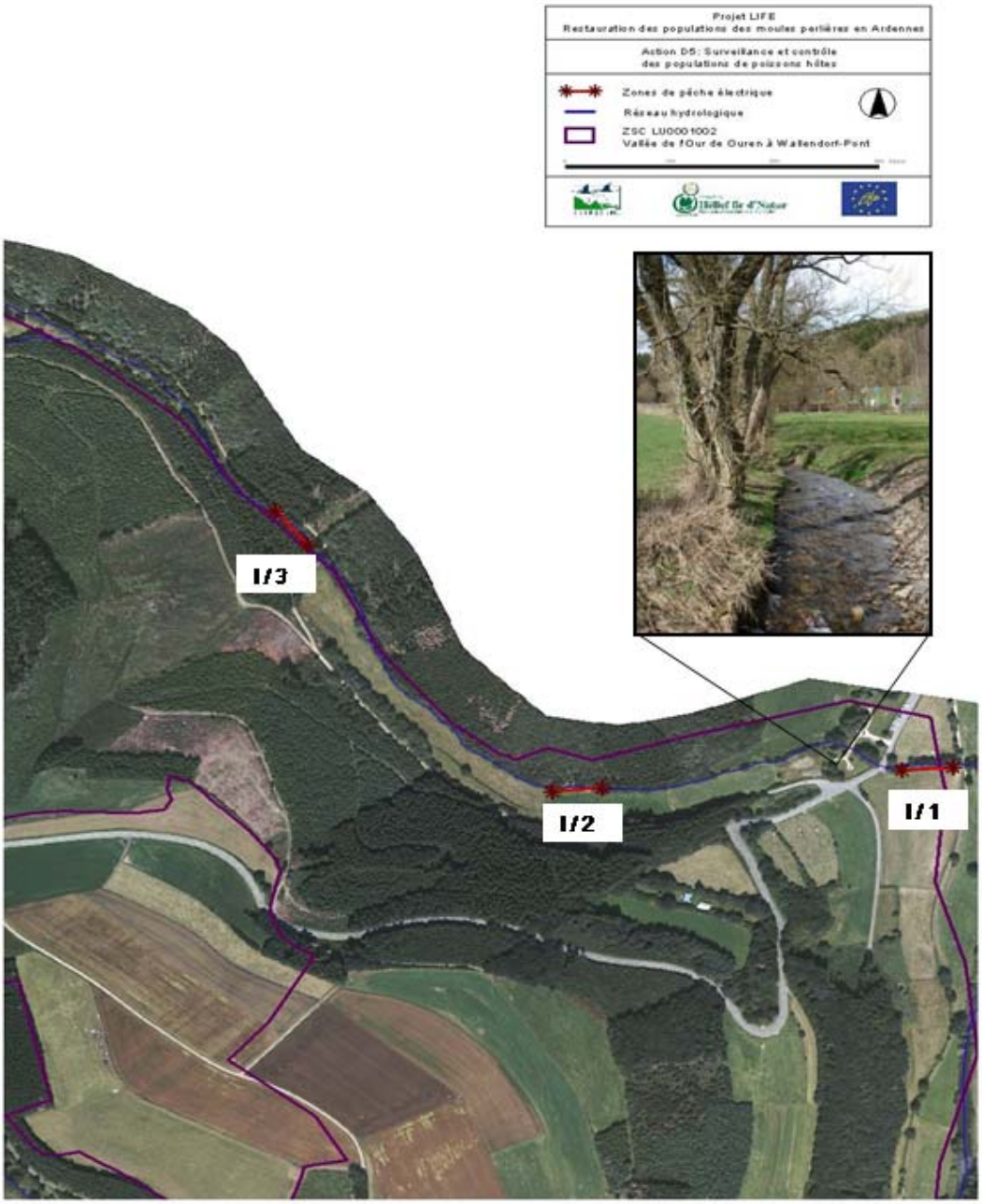

Figure 2 Location of the 3 stretches (I/1-I/3 red lines) analysed by electro-fishing in the Reibaach.

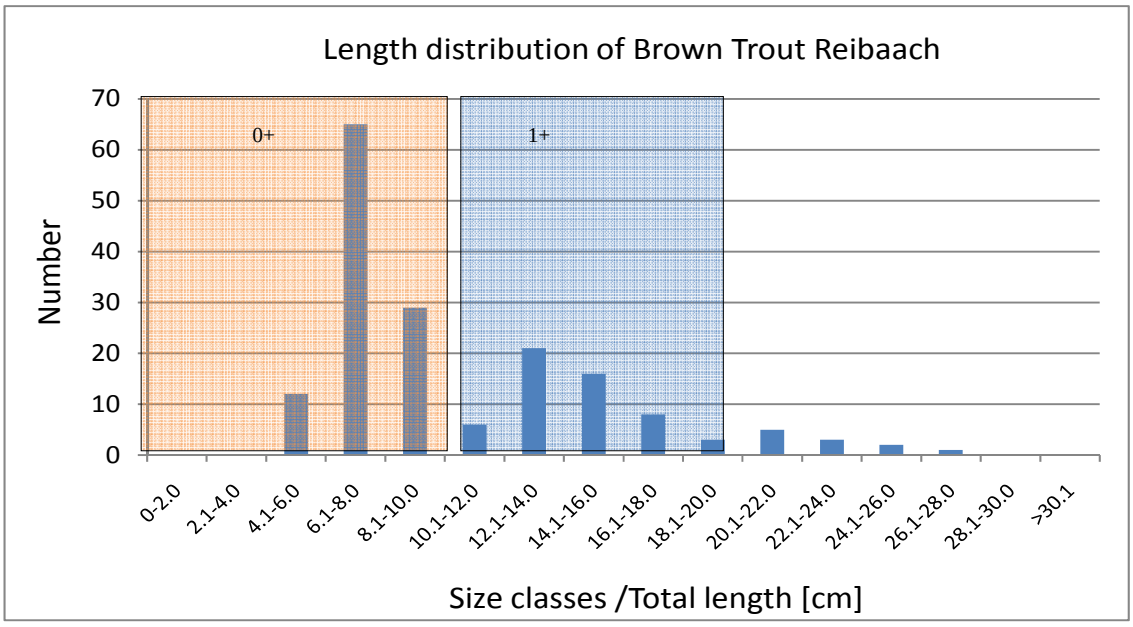

Figure 3 Length distribution of Brown Trout in the Reibaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

There were two species belonging to the epirithral, Brown Trout (*Salmo trutta fario*) and Bullhead (*Cottus gobio*) were both present in the Reibaach. Each of these species was recorded in each of the three river stretches sampled. The sampling yielded 171 Brown Trout which accounted for 80% of the population whilst 43 Bullhead accounted for the remaining 20%. The size classes for the Brown Trout individuals caught is shown in Figure 3.

The 0+ age class is well represented suggesting that natural reproduction took place in the year 2007. Individuals in the 1+ category is also well represented accounting for 35% of the total population. There were 11 individuals recorded which exceeded a length of 20 cm. The length of *Cottus gobio* ranged between 2.0 and 10.2 cm indicating that this species also reproduces in this stream. Based on the above results the calculated biomass is 88.2 kg/hectare and the density is 4976 individuals per hectare (Table 4). This is a significant improvement on the findings in 2007. The average level of conductivity for the three stretches sampled is 174.46 µS/cm which is high for the tributary of a Freshwater Pearl Mussel Stream. The average oxygen level and concentration is 10.57 mg/l and 96.3% which is good for the survival of Brown Trout.

3.2. Nivelsbaach

Date of fishing:	29/10/2008
Zone:	Epirithral
Number of stretches:	1 (II/1, location see Figure 4)
pH:	Stretch 1: Not measured
Conductivity:	Stretch 1: Not measured
Temperature:	Stretch 1: Not measured
Oxygen level (mg/l)	Stretch 1: Not measured
Oxygen saturation (%)	Stretch 1: Not measured

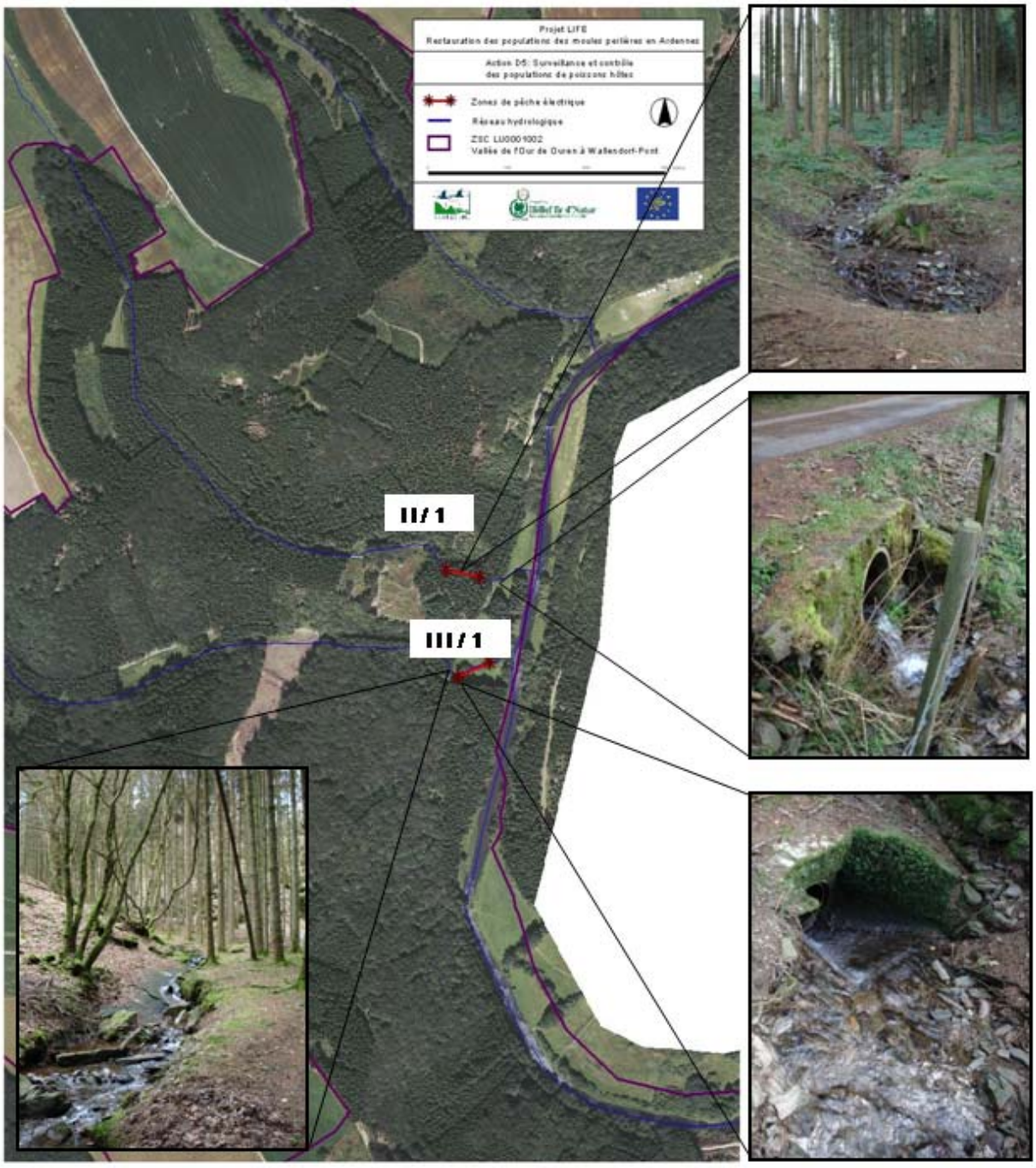

Figure 4 Location of the 2 stretches (red lines) analysed by electro-fishing in the Nivelsbaach and Schelsbaach.

No fish species were detected during the sampling by electro-fishing in the Nivelsbaach. The stretch sampled was located upstream of a pipe culvert (Figure 4, middle right). This artificial construction makes the migration of fish upstream impossible. The riparian zone of the section analysed was planted with spruce (Figure 4, top right). The stretch below the pipe construction was not sampled. However as for the Schelsbaach (see 3.3) one can assume that in this section Brown Trout was present in low numbers. Water parameters for this stretch were not measured.

3.3. Schelsbaach

Date of fishing:	29/10/2008
Zone:	Epirithral
Number of stretches:	1 (III/1, location see Figure 4)
pH:	Stretch 1: 8.02
Conductivity:	Stretch 1: 313 µS/cm
Temperature:	Stretch 1: 8.1˚C
Oxygen level (mg/l)	Stretch 1: 10.72 mg/l
Oxygen saturation (%)	Stretch 1: 94.5%

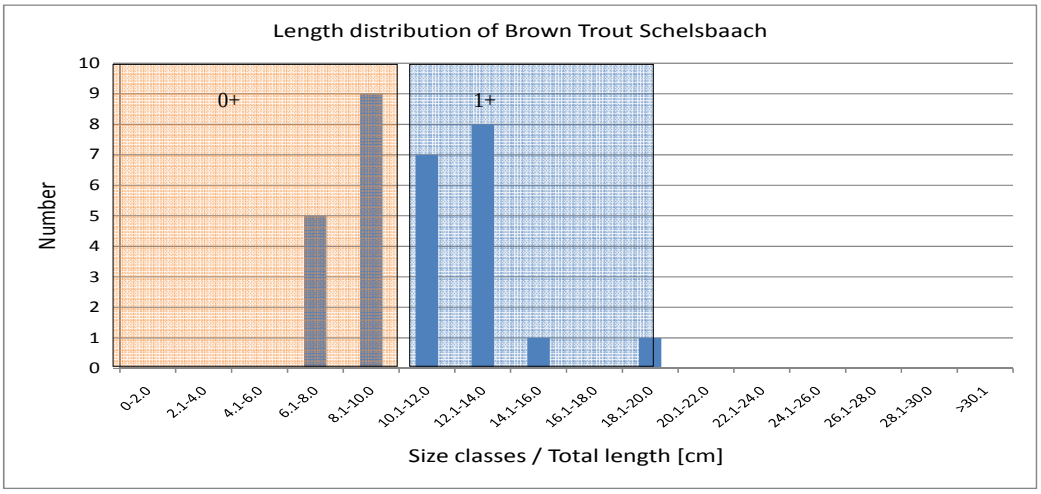

Figure 5 Length distribution of Brown Trout in the Schelsbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

One fifty metre stretch downstream of a pipe culvert (Figure 4; bottom right) was analysed by electro-fishing. Brown Trout was the only species detected on this sampling date with a total of 21 individuals. Figure 5 presents the population dynamics of the Brown Trout in this stream. There were 14 individuals in the 0+ range meaning that reproduction is likely to have occurred in this stream. There were 17 individuals in the 1+ range but no individuals over 20 cm in length. This is an improvement of the results of last year (21 up to 31). In a test sampling above the pipe culvert in 2007, no fish were caught showing a barrier to movement in the stream system. Table 4 presents the calculations of overall fish population in the Schelsbaach. The biomass calculations show a total of 55.1 kg/ hectare and a density of 3647.1 individuals per hectare. The level of conductivity for this stretch is 313 µS/cm which is extremely high for the tributary of a Freshwater Pearl Mussel Stream. The oxygen level and concentration is 10.72 mg/l and 94.5% which is good for the survival of Brown Trout.

3.4 Jansschleederbaach

Date of fishing:	29/10/2008		
Zone:	Epirithral		
Number of stretches:	3 (IV/1 – IV3, location see Figure 6)		
pH:	Stretch 1: 7.75	Stretch 2: 7.82	Stretch 3: 7.79
Conductivity:	Stretch 1: 193.7 µS/cm	Stretch 2: 195.9 µS/cm	Stretch 3: 196.7 µS/cm
Temperature:	Stretch 1: 7˚C	Stretch 2: 7.7˚C	Stretch 3: 8.3˚C
Oxygen level (mg/l)	Stretch 1: 11.3 mg/l	Stretch 2: 10.94 mg/l	Stretch 3: 11.05 mg/l
Oxygen saturation (%)	Stretch 1: 97.7%	Stretch 2: 97.5%	Stretch 3: 98.2%

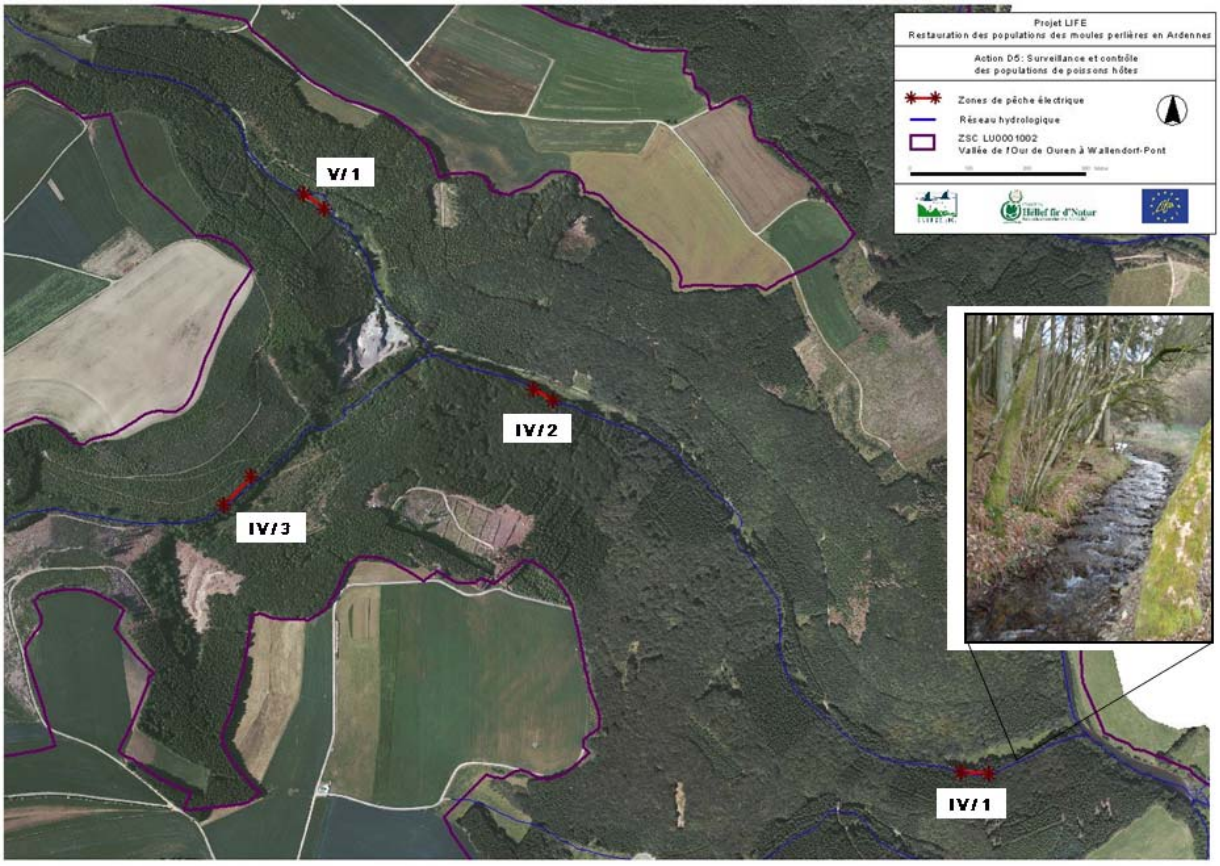

Figure 6 Location of the 3 stretches (red lines) analysed by electro-fishing in the Jansschleederbaach and 1 stretch (V/1) analysed in the Roupelsbaach.

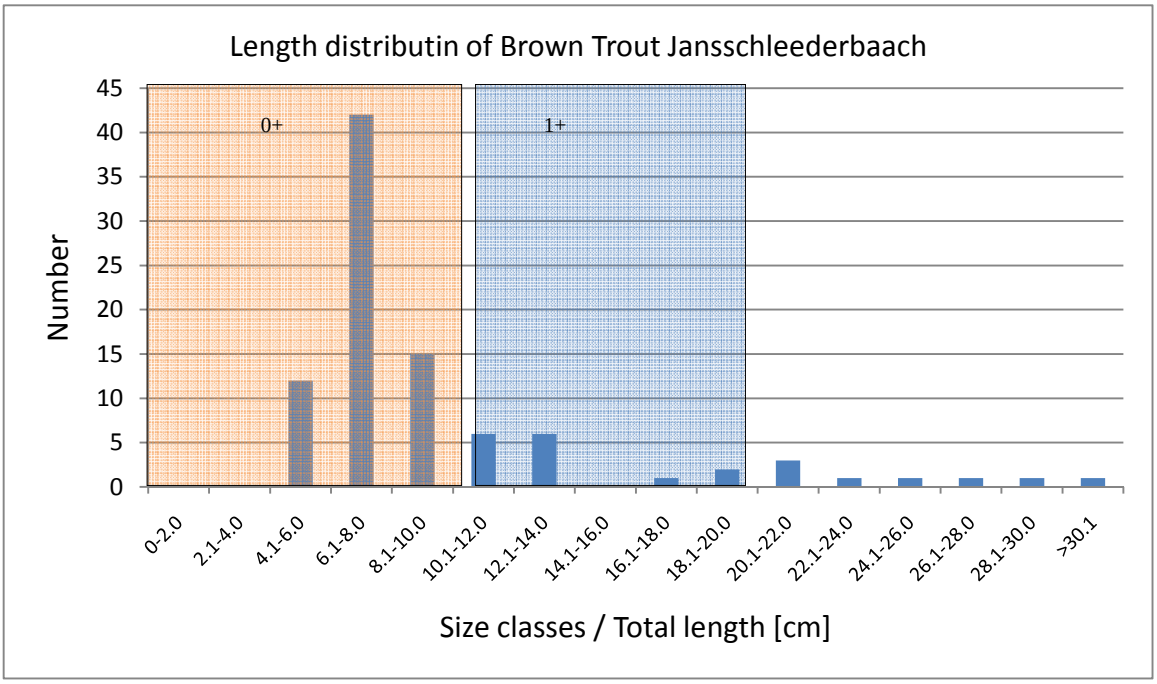

Figure 7 Length distribution of Brown Trout in the Jansschleederbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

Three stretches of the Jansschleederbaach were sampled by electro-fishing totalling 150 metres in length (Figure 6). Two species were recorded; Brown Trout (*Salmo trutta fario*) and Bullhead (*Cottus gobio*). There were 5 individuals of Bullhead caught which ranged in length from 7.5 cm to 9.2 cm. There were 92 individuals of Brown Trout caught which accounted for 95% of the sample number. These individuals ranged in length from 5.4 cm to 32.7 cm. The population dynamics of the Brown Trout population are shown in Figure 7.

The 0+ age classes are well represented suggesting that natural reproduction has taken place in the previous year. The 0+ category accounts for 75 of the 92 individuals, the 1+ category is significantly less well represented with only 15 individuals.

This is however a vast improvement on the previous year as pipe culverts were removed in 2005 and 2006 as part of the INTERREG III A-Program (NatOur), therefore this population is in a state of recovery. There were 8 individuals that exceeded 20 cm in length and one individual that exceeded 30 cm in length.

Based on the above results the calculated biomass is 91.4 kg/hectare and the density is 5555.6 individuals per hectare (Table 4). The average level of conductivity for the three stretches sampled is 195 µS/cm which is very high for the tributary of a Freshwater Pearl Mussel Stream. The average oxygen level and concentration is 11.09 mg/l and 97.8% which is good for the survival of Brown Trout.

3.5 Roupelsbaach

Date of fishing:	29/10/2008
Zone:	Epirithral
Number of stretches:	1 (V1, location see Figure 6)
pH:	Stretch 1: 7.79
Conductivity:	Stretch 1: 189.1 µS/cm
Temperature:	Stretch 1: 8.8˚C
Oxygen level (mg/l)	Stretch 1: 10.72 mg/l
Oxygen saturation (%)	Stretch 1: 98.6%

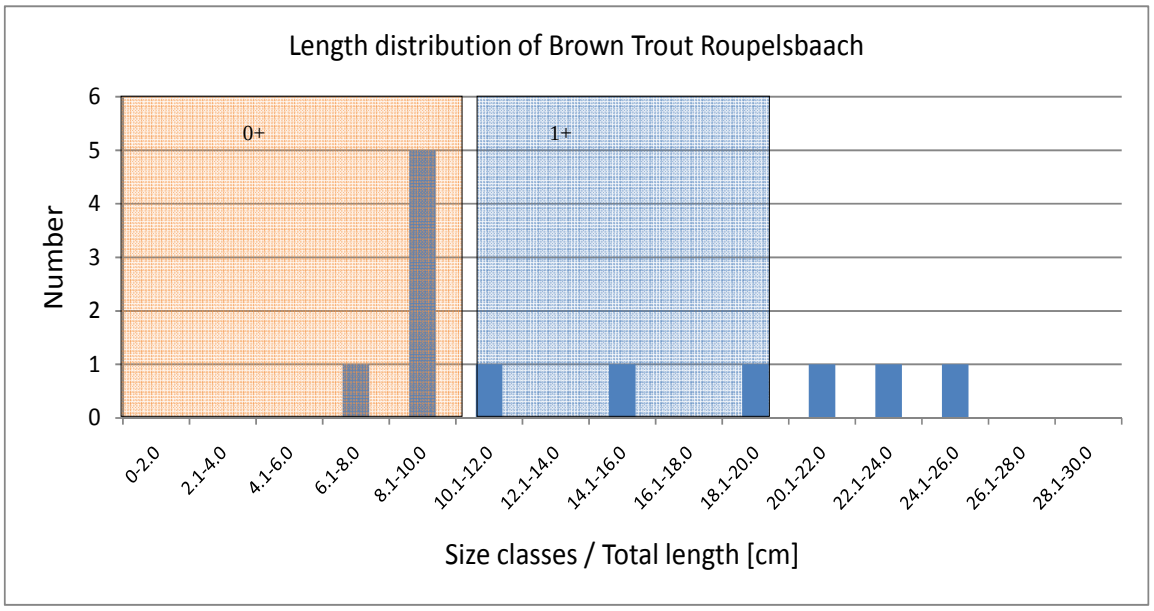

Figure 8 Length distribution of Brown Trout in the Roupelsbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

The Roupelsbaach is a tributary of the Jansschleederbaach. A large pipe culvert in the vicinity of the confluence between these two streams was previously blocking fish migrating from the Jansschleederbaach into the Roupelsbaach until it was removed in 2006 as part of the INTERREG III A-Program (NatOur). One fifty metre stretch of the Roupelsbaach was sampled by electro-fishing. Brown Trout (*Salmo trutta fario*) was the only species recorded of which there were 12 individuals ranging in length from 7.2 cm to 24.3 cm. The population dynamics of the Brown Trout population are shown in Figure 8.

The 0+ age class accounts for 50% of the population suggesting that natural reproduction has taken place in the previous year. The 1+ category is significantly less well represented with only 3 individuals. There were 3 individuals that exceeded 20 cm in length. Based on the above results the calculated biomass is 199.1 kg/hectare and the density is 4000 individuals per hectare (Table 4). This is an improvement in the status of the fish population when compared to the findings of the LIFE group in 2007. The level of conductivity for this stretch is 189.1 µS/cm which is very high for the tributary of a Freshwater Pearl Mussel Stream. The average oxygen level and concentration is 10.72 mg/l and 98.6% which is good for the survival of Brown Trout.

3.6 Feierbech

Date of fishing:	30/10/2008
Zone:	Epirithral
Number of stretches:	1 (VI/1, location see Figure 6)
pH:	Stretch 1: Not measured
Conductivity:	Stretch 1: Not measured
Temperature:	Stretch 1: Not measured
Oxygen level (mg/l)	Stretch 1: Not measured
Oxygen saturation (%)	Stretch 1: Not measured

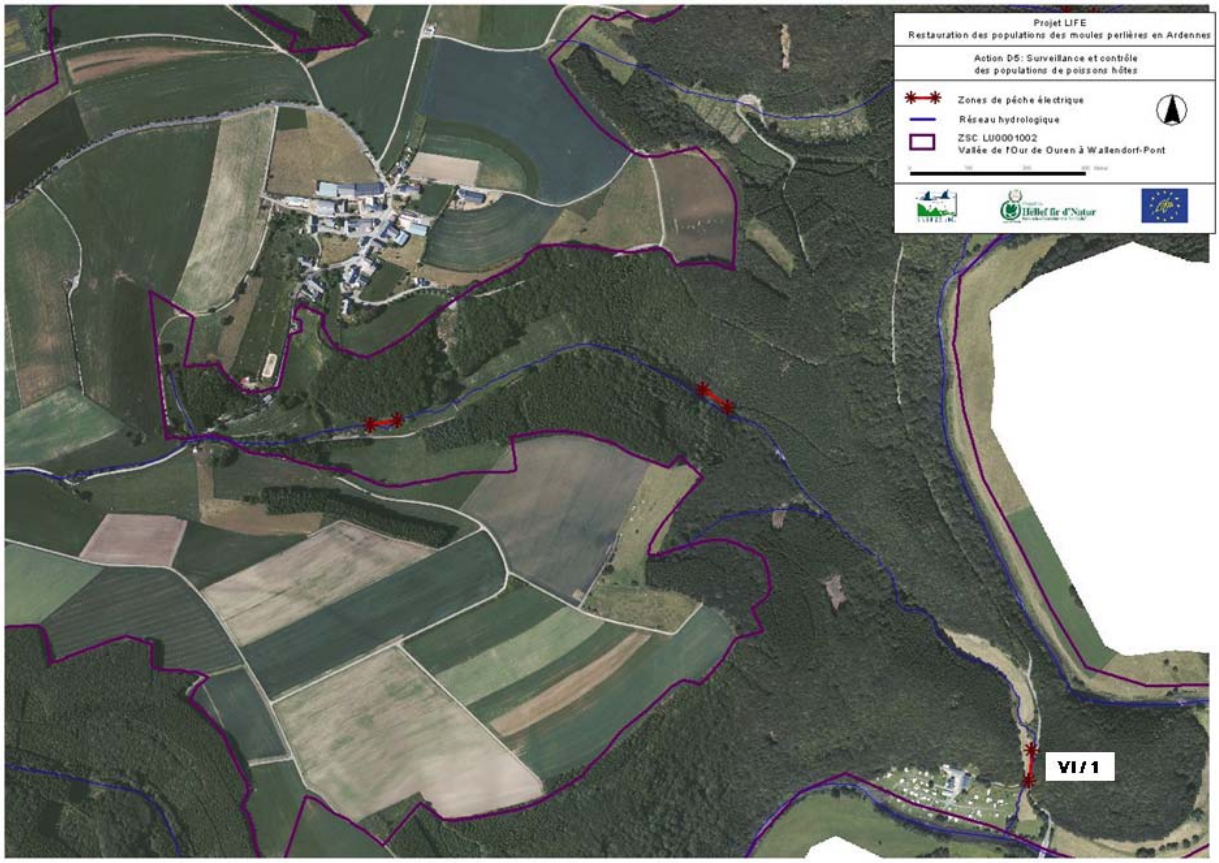

Figure 9 Location of the 3 stretches (red lines) analysed by electro-fishing in the Feierbech. Only the stretch VI/1 was analyzed.

The wastewater from the village of Kalborn was discharged directly into the Feierbech until 2006. It is now piped directly to a treatment facility at Tintesmühle. A pipe culvert is located close to the confluence of the Feierbech with the river Our and the stream is reported to run dry during the summer months (Armand Dichter pers. comm.) The Feierbech was sampled at one stretch by electro-fishing. Considering the problems outlined above it is not surprising that no species of fish were recorded. This is a similar situation to the findings of the LIFE group in 2006. According to Thielen *et al.* (2010) the water quality in this stream is not compliant with the requirements of a Freshwater Pearl Mussel stream; the conductivity levels and nitrate are

very high. But the levels recorded in the Schelsbaach that carries water from the wastewater treatment facility at Lieler are more elevated.

3.7 Hengeschterbaach

Date of fishing:	31/10/2008		
Zone:	Epirithral		
Number of stretches:	3 (VII/1 and VII/2, location see Figure 10 /Stretch VII/3 not shown on Figure 10)		
pH:	Stretch 1: 7.7	Stretch 2: 7.7	Stretch 3: 7.85
Conductivity:	Stretch 1: 167.3 µS/cm	Stretch 2: 176.4 µS/cm	Stretch 3: 235 µS/cm
Temperature:	Stretch 1: 6.3˚C	Stretch 2: 6.4˚C	Stretch 3: 6.8˚C
Oxygen level (mg/l)	Stretch 1: 13.19 mg/l	Stretch 2: 11.39 mg/l	Stretch 3: 11.06 mg/l
Oxygen saturation (%)	Stretch 1: 114.5%	Stretch 2: 97.5%	Stretch 3: 97%

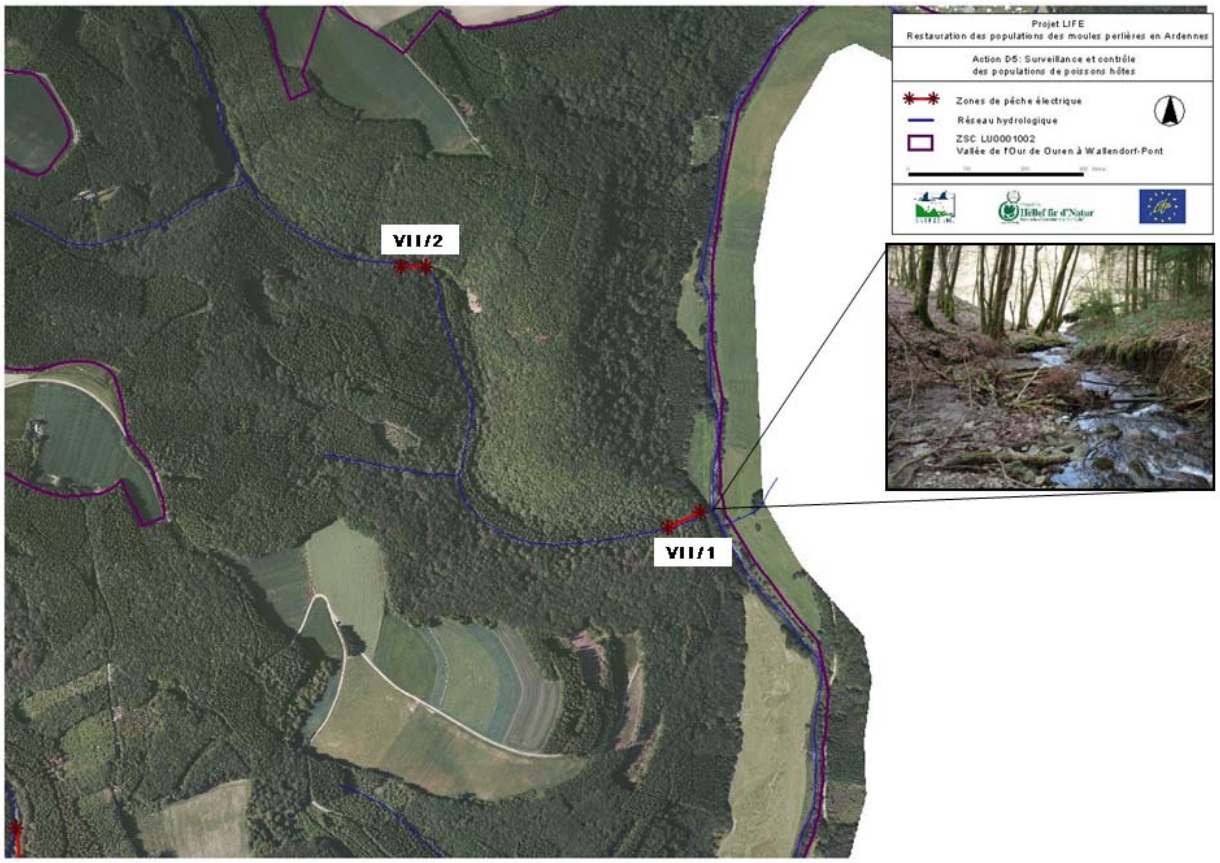

Figure 10 Location of the 2 stretches (red lines) analysed by electro-fishing in the Hengeschterbaach. Stretch 3 not shown.

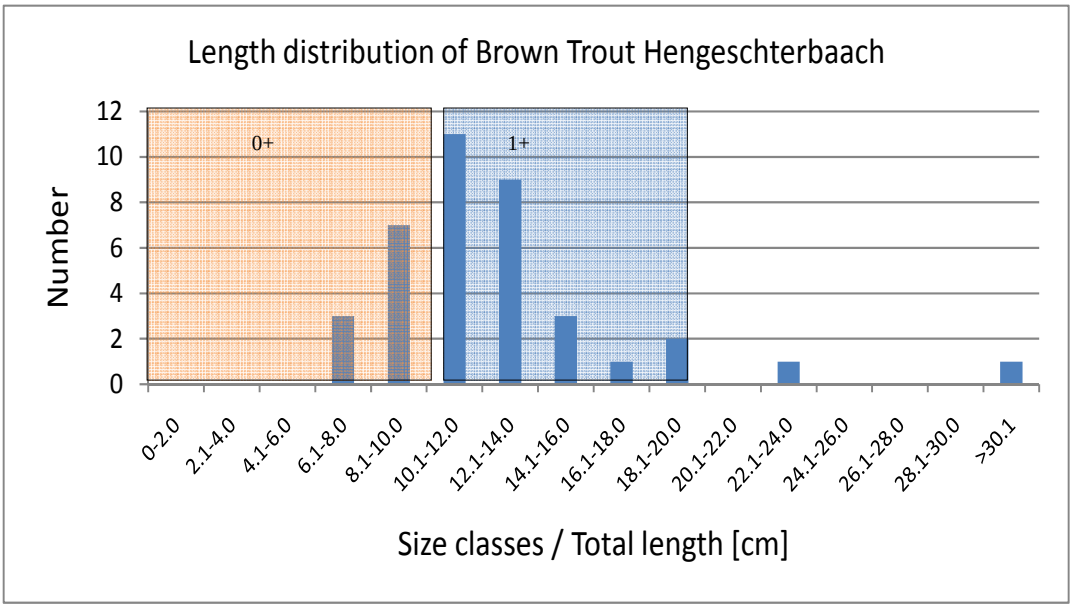

Figure 11 Length distribution of Brown Trout in the Hengeschterbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

The wastewater from the village of Heinerscheid was once discharged directly into the Hengeschterbaach. This was remediated in 2006 and the wastewater is now piped directly to the treatment facility at Tintesmühle.

Three stretches of the Hengeschterbaach were sampled by electro-fishing totalling 150 metres in length (Figure 10). Brown Trout (*Salmo trutta fario*) was the only species recorded in each of the three stretches. There were 38 individuals caught ranging in length from 7 cm to 31.6 cm. The population dynamics of the Brown Trout population are shown in Figure 11.

The 0+ age class is well represented with 10 individuals. This is not necessarily due to natural reproduction as a stocking programme was initiated by local anglers in 2007 but natural recolonisation cannot be ruled out. The 1+ category is very well represented with 26 individuals and could be partly due to the re-stocking. One individual was measured as 22.2 cm and another was 31.6 cm.

Based on the above results the calculated biomass is 40.4 kg/hectare and the density is 1381.8 individuals per hectare (Table 4). The average level of conductivity for the three stretches sampled is 192.9 µS/cm which is very high for the tributary of a Freshwater Pearl Mussel stream. The average oxygen level and concentration is 11.99 mg/l and 103% which is very good for the recovery of the population of Brown Trout.

3.8 Stroumbaach

Date of fishing:	30/10/2008		
Zone:	Epirithral		
Number of stretches:	3 (VIII/1-VIII/3, location see Figure 12)		
pH:	Stretch 1: Not measured	Stretch 2: Not measured	Stretch 3: 7.58
Conductivity:	Stretch 1: Not measured	Stretch 2: Not measured	Stretch 3: 159.5 µS/cm
Temperature:	Stretch 1: Not measured	Stretch 2: Not measured	Stretch 3: 7.6˚C
Oxygen level (mg/l)	Stretch 1: Not measured	Stretch 2: Not measured	Stretch 3: 11.02 mg/l
Oxygen saturation (%)	Stretch 1: Not measured	Stretch 2: Not measured	Stretch 3: 97.2%

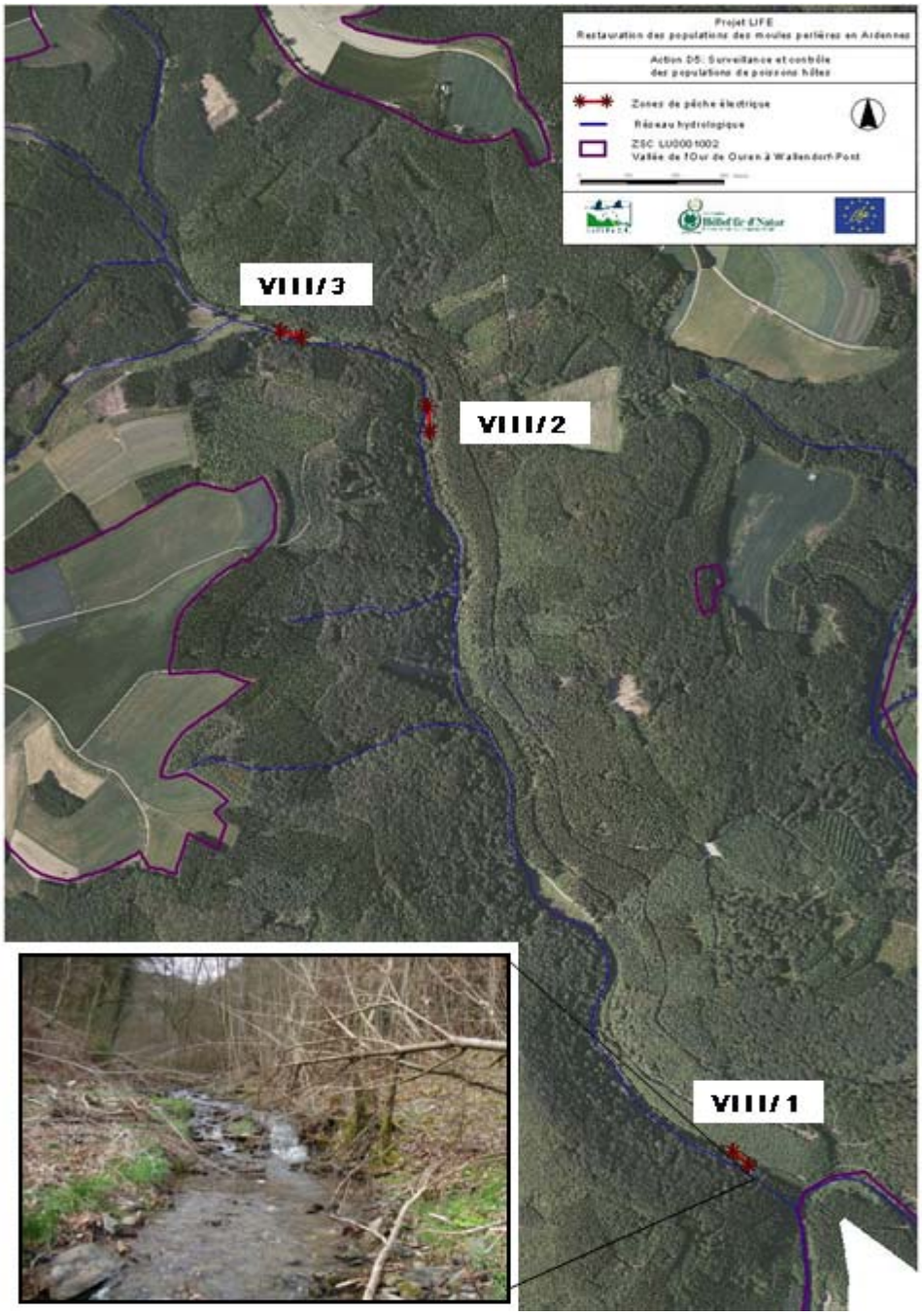

Figure 12: Location of the 3 stretches (red lines) analysed by electro-fishing in the Stroumbaach.

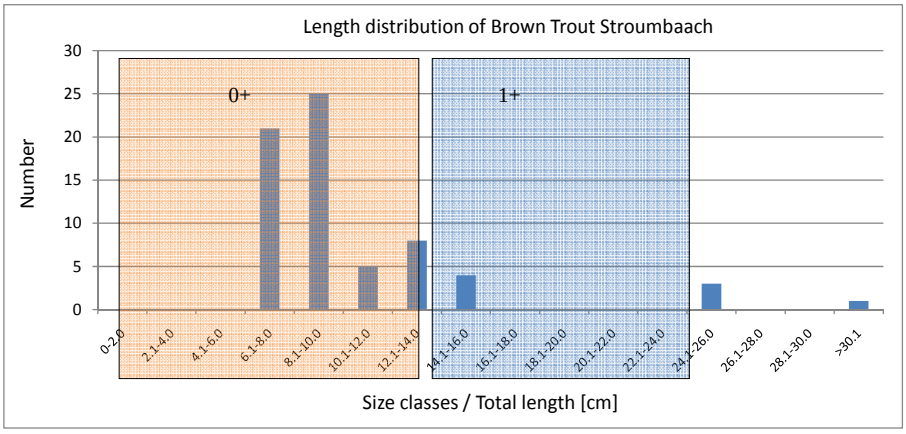

Figure 13 Length distribution of Brown Trout in the Stroumbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

Three stretches of the Stroumbaach were sampled by electro-fishing totalling 150 metres in length (Figure 12). Two species were recorded; Brown Trout (*Salmo trutta fario*) and Bullhead (*Cottus gobio*). There were 9 individuals of Bullhead caught which ranged in length from 3.8 cm to 8.6 cm. There were 67 individuals of Brown Trout caught which accounted for 88% of the sample number. These individuals ranged in length from 6.5 cm to 32.8 cm. The population dynamics of the Brown Trout population are shown in Figure 13.

The 0+ age classes are well represented suggesting that natural reproduction has taken place in the previous year. However, this stream was artificially stocked by local anglers with Brown Trout in 2006. This could be affecting the current results and there is a difficulty in identifying the self-sustaining status of this population.

The 0+ category accounts for 46 of the 76 individuals recorded or 60% of the population, the 1+ category is less well represented with 17 individuals. Three individuals were measured between 24.1 cm and 26 cm whilst one individual exceeded a length of 30 cm. Based on the above results the calculated biomass is 63.8 kg/hectare and the density is 3234 individuals per hectare (Table 4). This measurement of fish population is very good but it has decreased when it is compared with the findings of the LIFE group in 2007. The water parameters were not measured in the first two stretches of the river. The level of conductivity in the third stretch was 159.5 µS/cm which much lower than many of the other tributaries of the Our. It does not comply with the guidelines specified for a Freshwater Pearl Mussel stream. The oxygen level and concentration is 11.02 mg/l and 97.2% respectively which is good for the survival of Brown Trout.

3.9 Kenzelbaach

Date of fishing:	10/11/2008		
Zone:	Epirithral		
Number of stretches:	3 (IX/1-IX/3, location see Figure 14)		
pH:	Stretch 1: 7.85	Stretch 2: 7.73	Stretch 3: 7.83
Conductivity:	Stretch 1: 180.4 µS/cm	Stretch 2: 182.5 µS/cm	Stretch 3: 192.5 µS/cm
Temperature:	Stretch 1: 7.85˚C	Stretch 2: 7.73˚C	Stretch 3: 7.83˚C
Oxygen level (mg/l)	Stretch 1: 11.4 mg/l	Stretch 2: 11.25 mg/l	Stretch 3: 10.37 mg/l
Oxygen saturation (%)	Stretch 1: 102.6%	Stretch 2: 93%	Stretch 3: 94.5%

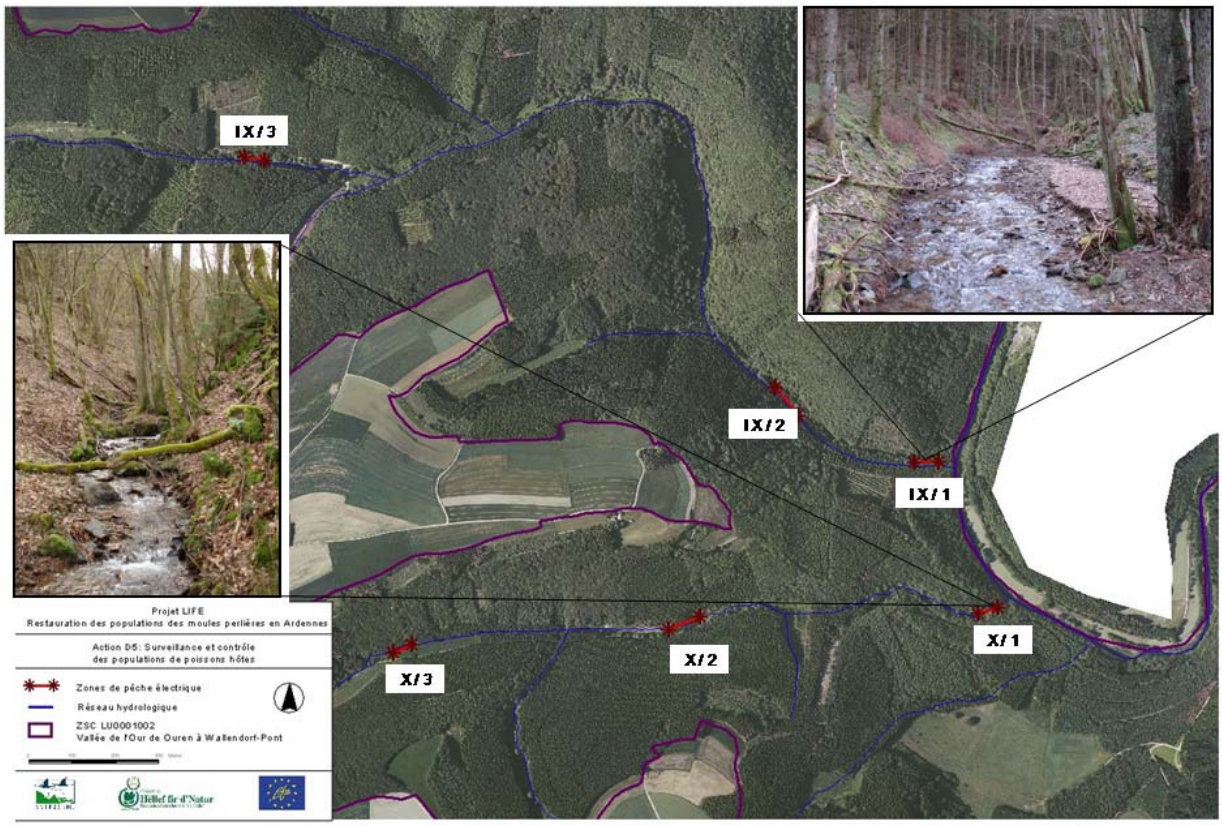

Figure 14 Location of the 3 stretches (red lines) analysed by electro-fishing in both the Kenzelbaach and the Ruederbaach.

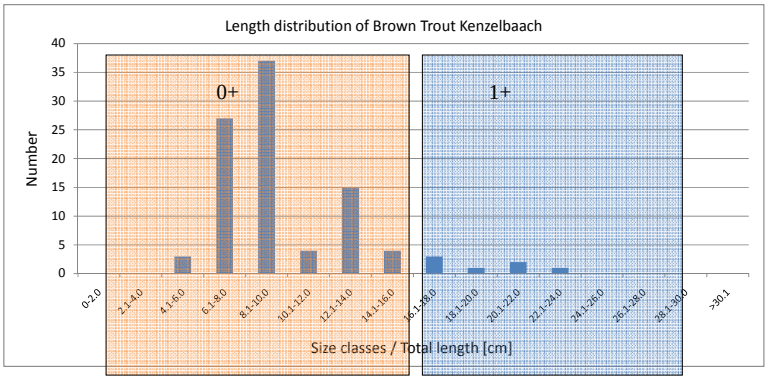

Figure 15 Length distribution of Brown Trout in the Kenzelbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

Three stretches of the Kenzelbaach were sampled by electro-fishing totalling 150 metres in length (Figure 14). Brown Trout (*Salmo trutta fario*) was the only species recorded in each of the three stretches. There were 97 individuals caught ranging in length from 4.9 cm to 22.5 cm. The population dynamics of the Brown Trout population are shown in Figure 15.

The 0+ age class is very well represented with 67 individuals. The 1+ category is also well represented with 27 individuals. Three individuals exceeded a length of 20 cm.

Similar to the Hengeschterbaach and the Stroumbaach, a stocking programme was carried out in the Kenzelbaach in 2006. Therefore the results could be partly affected by this. The health of the population should be monitored closely in the future to ascertain of the population is self-sustaining sufficiently.

Based on the above results the calculated biomass is 50.6 kg/hectare and the density is 3180.3 individuals per hectare (Table 4). The average level of conductivity for the three stretches sampled is 185.13 µS/cm which is very high for the tributary of a Freshwater Pearl Mussel stream. The average oxygen level and concentration is 11 mg/l and 96.7% which provides a good habitat for Brown Trout.

3.10 Ruederbaach

Date of fishing:	11.11.2008		
Zone:	Epirithral		
Number of stretches:	3 (X/1 – X/3, location see Figure 14)		
pH:	Stretch 1: 7.88	Stretch 2: 8.01	Stretch 3: 7.91
Conductivity:	Stretch 1: 186.3 µS/cm	Stretch 2: 207 µS/cm	Stretch 3: 239 µS/cm
Temperature:	Stretch 1: 9.7˚C	Stretch 2: 9˚C	Stretch 3: 9.2˚C
Oxygen level (mg/l)	Stretch 1: 10.52 mg/l	Stretch 2: 10.45 mg/l	Stretch 3: 10.85 mg/l
Oxygen saturation (%)	Stretch 1: 96.2%	Stretch 2: 94.6%	Stretch 3: 99.6%

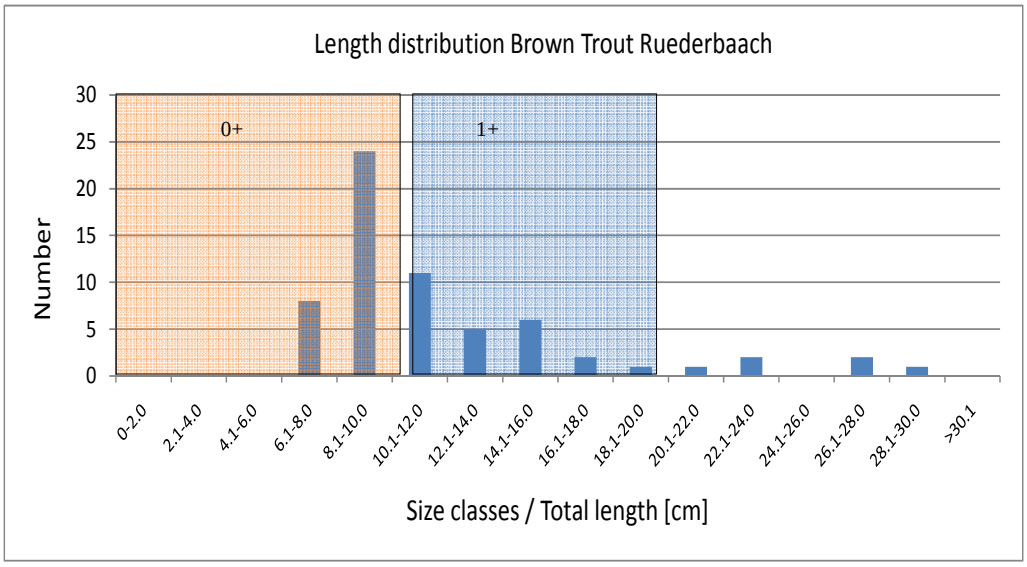

Figure 16: Length distribution of Brown Trout in the Ruederbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

Three stretches of the Ruederbaach were sampled by electro-fishing totalling 150 metres in length (Figure 14). Brown Trout (*Salmo trutta fario*) was the only species recorded in each of the three stretches. There were 63 individuals caught ranging in length from 6.8 cm to 29.5 cm. The population dynamics of the Ruederbaach are shown in Figure 16.

The 0+ age class is well represented with 32 individuals. This is less than the observations made in the Stroumbaach and the Kenzelbaach but it has to be noted that a stocking programme was not carried out in this stream. The 1+ category is very well represented with 25 individuals; six individuals exceeded a measurement of 20 cm.

Based on the above results the calculated biomass is 105.2 kg/hectare and the density is 3600 individuals per hectare (Table 4). This is very good, particularly as an artificial stocking programme is not affecting the results and it is a significant improvement on the result recorded by the LIFE group in 2007. The average level of conductivity for the three stretches sampled is 210.76 µS/cm which is very high for the tributary of a Freshwater Pearl Mussel stream. The average oxygen level and concentration is 10.6 mg/l and 96.8% which is very good for a Brown Trout habitat.

3.11 Etschenterbaach

Date of fishing:	11.11.2008		
Zone:	Epirithral		
Number of stretches:	3 (XI/1 – XI/3, location see Figure 17)		
pH:	Stretch 1: 7.88	Stretch 2: 7.71	Stretch 3: 7.76
Conductivity:	Stretch 1: 165.8 µS/cm	Stretch 2: 161.7 µS/cm	Stretch 3: 156 µS/cm
Temperature:	Stretch 1: 9.4˚C	Stretch 2: 9.1˚C	Stretch 3: 8.9˚C
Oxygen level (mg/l)	Stretch 1: 10.8 mg/l	Stretch 2: 10.82 mg/l	Stretch 3: 10.82 mg/l
Oxygen saturation (%)	Stretch 1: 97.7%	Stretch 2: 98.1%	Stretch 3: 98%

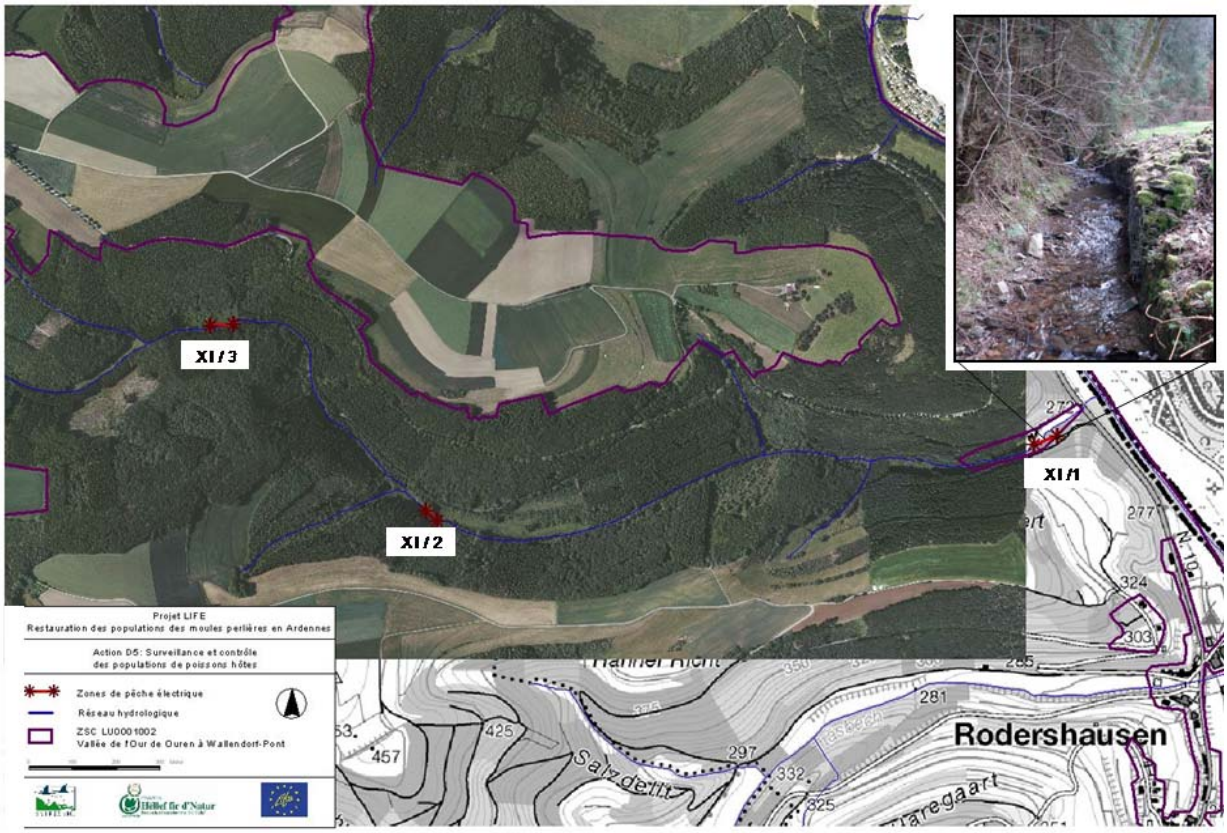

Figure 17 Location of the 3 stretches (red lines) analysed by electro-fishing in the Etschenterbaach.

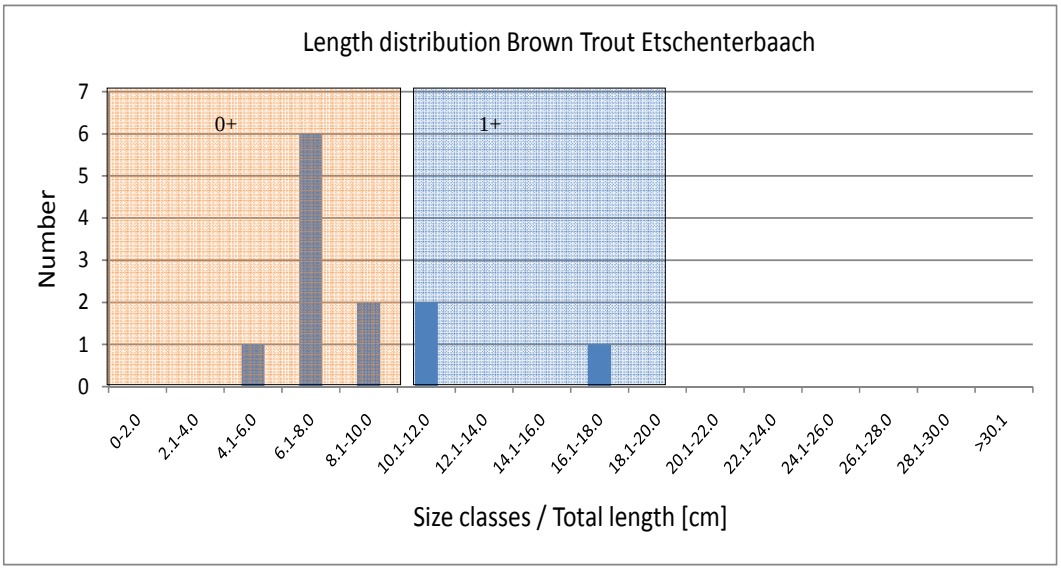

Figure 18 Length distribution of Brown Trout in the Etschenterbaach. First year trout (O+) and second year trout (1+) are highlighted by coloured rectangles.

Three stretches of the Etschenterbaach were sampled by electro-fishing totalling 150 metres in length (Figure 17). Brown Trout (*Salmo trutta fario*) was the only species recorded in each of the three stretches. This finding is similar to the report published in 2007 as there were no Bullhead found in this stream previously. There were only 12 individuals caught ranging in length from 6 cm to 16.8 cm. The population dynamics of the Etschenterbaach are shown in Figure 18.

The 0+ age class showed a total of 9 individuals, there were 3 individuals in the 1+ category. No individuals exceeding a measurement of 20 cm were recorded.

Based on the above results the calculated biomass is 6.4 kg/hectare and the density is 705.9 individuals per hectare (Table 4). The population of Brown Trout in the Etschenterbaach is very small particularly as 75% of the sample was caught in one 50 metre stretch alone. Two individuals were caught in the second stretch and only one large fish measuring 16.8 cm in the third stretch.

The average level of conductivity for the three stretches sampled is 161.16 µS/cm which is high for the tributary of a Freshwater Pearl Mussel stream. The average oxygen level and concentration is 10.81 mg/l and 97.93% which is very good for a Brown Trout habitat.

3.12 River Our

Table 1 Electro-fishing results: River Our (Grossenauel) 2008.

Location:River Our (Grossenauel)		Date:10/09/2008	Total
Species (Latin)	Species (English)	Species (Deutsch)	
Phoxinus phoxinus	Minnow	Elritze	601
Alburnoides bipunctatus	Spirlin/Riffle Minnow	Schneider	425
Gobio gobio	Gudgeon	Gründling	204
Cottus gobio	Bullhead	Groppe	114
Barbatula barbatula	Stone Loach	Bachschmerle	241
Leuciscus cephalus	Chub	Döbel	156
Salmo trutta fario	Brown Trout	Forelle	149
Barbus barbus	Barbel	Barbel	16
Rutilus rutilus	Roach	Plötze	2
Total			1908

Table 1 presents the results of the electro-fishing sample of a 100 metre stretch of the river Our at Grossenauel in September 2008. The most abundant species is Minnow (*Phoxinus phoxinus*) showing a total of 601 individuals. There were also a large number of Spirlin (*Alburnoides bipunctatus*) and Gudgeon (*Gobio gobio*) caught. The number of Brown Trout (*Salmo trutta fario*) in this stretch of 149 is very good.

Table 2 Electro-fishing results: River Our 2009.

Date: 28/10/2009	Area: 100 metres long, 10 metres wide		Size Class (cm)						
Species (Latin)	Species (English)	Species (Deutsch)	< 6	6 to 10.9	11 to 20.9	21 to 30.9	31 to 40	> 40	Total
Phoxinus phoxinus	Minnow	Elritze	390	264	26				680
Alburnoides bipunctatus	Spirlin/Riffle Minnow	Schneider	32	42	41				115
Gobio gobio	Gudgeon	Gründling	28	28	45	1			102
Cottus gobio	Bullhead	Groppe	31	36	16				83
Barbatula barbatula	Stone Loach	Bachschmerle	25	37	12				74
Chondrostoma nasus	Nase	Nase	14	11	1		3		29
Leuciscus cephalus	Chub	Döbel	2	3	14	8			27
Salmo trutta fario	Brown Trout	Bachforelle			5	5	4		14
Leuciscus leuciscus	Dace	Hasel	7	1	2				10
Esox lucius	Pike	Hecht			1		1		2
Lampetra planeri	Brook Lamprey	Bachneunauge				1			1
Total			529	422	163	15	8	0	1137

Table 2 presents the results of the electro-fishing sample of a 100 metre stretch of the river Our in October 2009. The most abundant species is Minnow (*Phoxinus phoxinus*) showing a total of 680 individuals. The number of Spirlin (*Alburnoides bipunctatus*) is significantly less than the catch in 2008 with 115 individuals. The number of Gudgeon (*Gobio gobio*) caught has decreased by 50% when compared to the results of 2008. There were a total of 14 Brown Trout *Salmo trutta fario*) caught; none of these were in the 0+ category, five individuals were from the 1+ category. The majority of the individuals (nine) exceeded a length of 21 cm. One Pike (*Esox lucius*) and one Brook Lamprey (*Lampetra planeri*) were also caught.

Table 3 Electro-fishing results: River Our 2010.

Date: 19/05/2010	Area: 100 metres long, 10 metres wide		Size Class (cm)						
Species (Latin)	Species (English)	Species (Deutsch)	< 6	6 to 10.9	11 to 20.9	21 to 30.9	31 to 40	> 40	Total
Phoxinus phoxinus	Minnow	Elritze	115	22					137
Alburnoides bipunctatus	Spirlin/Riffle Minnow	Schneider	22						22
Gobio gobio	Gudgeon	Gründling	17	8	11				36
Cottus gobio	Bullhead	Groppe	63	26	1				90
Barbatula barbatula	Stone Loach	Bachschmerle	115	99					214
Leuciscus cephalus	Chub	Döbel	6	1				1	8
Salmo trutta fario	Brown Trout	Forelle		3	4	1			8
Barbus barbus	Barbel	Barbe				1	3		4
Esox lucius	Pike	Hecht			1				1
Chondrostoma nasus	Nase	Nase						1	1
Total			338	159	17	2	3	2	521

Table 3 presents the results of the electro-fishing sample of a 100 metre stretch of the river Our in May 2010. The most abundant species is Minnow (*Phoxinus phoxinus*) showing a total of 137 individuals. This is significantly less than in previous years but may be due to the period of sampling. The numbers of Stone Loach (*Barbatula barbatula*) is comparable to the catch of 241 individuals in 2008. There were a total of 8 Brown Trout *Salmo trutta fario*) caught; three of these were in the 0+ category and four in the 1+ category. Unlike the results in 2009 there was only one individual that exceeded a length of 20 cm. The majority of the individuals (nine) exceeded a length of 21 cm. One Pike (*Esox lucius*) and one Nase (*Chondrostoma nasus*) were also caught.

3.13 Overall fish population

Table 4 Fish population in the streams analysed. (Ind. = Individuals; ha = hectare).

Stream	Individuals	Species	Ind./100m	kg/100m	Ind./ha	kg/ha
Reibaach	214	2	107.0	1.9	4976.7	88.2
Nivelsbaach	0	0	0.0	0.0	0.0	0.0
Schelsbaach	31	1	62.0	0.9	3647.1	55.1
Roupelsbaach	12	1	24.0	1.2	4000.0	199.1
Jansschleederbaach	125	2	83.3	1.4	5555.6	91.4
Feierbech	0	0	0.0	0.0	0.0	0.0
Hengeschterbaach	38	1	25.3	0.7	1381.8	40.4
Stroumbaach	76	2	50.7	1.0	3234.0	63.8
Kenzelbaach	97	1	64.7	1.0	3180.3	50.6
Ruederbaach	63	1	42.0	1.2	3600.0	105.2
Etschenterbaach	12	1	8.0	0.1	705.9	6.4
Total	668	2				
Average			42.5	0.9	2752.9	63.7

The total number of individuals caught for each of the tributaries is outlined in Table 4. The total catch for each stream is then used to calculate the number of individuals per 100 metre stretch of stream, weight (kg) per 100 metre stretch of stream and individuals and weight per hectare of river catchment. The margin of error for each of these calculations is large but it allows for broad comparison of the health status of each tributary with regard to its fish population. The accuracy of these calculations is largely affected by sample size. The lower the sample size; the greater the margin of error. The Nivelsbaach and the Feirbech were the only streams where no fish were detected. Brown Trout (*Salmo trutta fario*) was detected in each of the other nine streams, Bullhead (*Cottus gobio*) was present in three of the nine streams. The Reibach and the Jansschleederbaach were the streams with the best health status but the Reibach contained the most number of individuals. Table 5 summarises the length distribution of the Brown Trout population for each of the tributaries sampled.

Table 5: Length frequency distribution of Brown Trout in the 11 tributaries of the river Our.

Size classes	0-2	2.1-4	4.1-6	6.1-8	8.1-10	10.1-12	12.1-14	14.1-16	16.1-18	18.1-20	20.1-22	22.1-24	24.1-26	26.1-28	28.1-30	>30.1	Total
Reibaach	0	0	12	65	29	6	21	16	8	3	5	3	2	1	0	0	171
Nivelsbaach																	
Schelsbaach	0	0	0	5	9	7	8	1	0	1	0	0	0	0	0	0	31
Roupelsbaach	0	0	0	1	5	1	0	1	0	1	1	1	1	0	0	0	12
Jansschleederbaach	0	0	12	42	15	6	6	0	1	2	3	1	1	1	1	1	92
Feierbech																	
Hengeschterbaach	0	0	0	3	7	11	9	3	1	2	0	1	0	0	0	1	38
Stroumbaach	0	0	0	21	25	5	8	4	0	0	0	0	3	0	0	1	67
Kenzelbaach	0	0	3	27	37	4	15	4	3	1	2	1	0	0	0	0	97
Ruederbaach	0	0	0	8	24	11	5	6	2	1	1	2	0	2	1	0	63
Etschenderbaach	0	0	1	6	2	2	0	0	1	0	0	0	0	0	0	0	12
Total	0	0	28	178	153	53	72	35	16	11	12	9	7	4	2	3	583

4. Discussion

All tributaries analysed are located in the low mountain area of the Our valley and belong to the epirithral. The oxygen content and saturation levels are generally very good in all of the tributaries but the conductivity is too elevated. This means that there are issues with the water quality in all of the tributaries but the Nivelsbaach and Feierbech are the only streams to show extremely detrimental effects. Brown Trout (*Salmo trutta fario*) and Bullhead (*Cottus gobio*) are the typical fish species for this region (Gebhardt & Ness, 1997) and were the only two species detected during the investigation. The Brook Lamprey (*Lampetra planeri*) could also be expected in this area (Gebhardt & Ness, 1997). The larvae of this species live in organic detritus on the riverbed. As the flow velocity in all streams is rather high, areas with fine sediments and detritus are scarce in these streams and thus also habitats for Brook Lampreys. Furthermore none of the eleven tributaries were explicitly checked for this species by electro-fishing. However one Brook Lamprey was caught during the 2009 population monitoring in the river Our. It cannot be deduced that Brook Lamprey are not living in the streams.

4.1 Reibaach

The Reibaach hosts a very good population of Brown Trout (*Salmo trutta fario*) and Bullhead (*Cottus gobio*). It was the stream that greatest number of individual fish was caught in. The Reibaach is used as a natural spawning ground as the 0+ class was very well represented during the sampling. There was also significant number present in the 1+ class and above 20 cm in length. The LIFE group reported that the numbers of fish were very good in 2007, yet it has improved further.

4.2 Nivelsbaach

As previously reported by the LIFE group; the pipe culvert is acting as a barrier to the migration of fish species in the Nivelsbaach. Also this stream is very small and may be unsuitable for use as a spawning ground particularly when it is known that this stream runs dry during summer months with very low precipitation.

4.3 Schelsbaach

The water quality in the Schelsbaach has improved significantly as the wastewater from the village of Lieler was once discharged directly into this stream. The wastewater is now cleaned at a treatment facility but according to the results presented by Thielen *et al.* (2010) the level of eutrophication in this stream remains high therefore the functionality of the facility comes into question.

This is re-enforced by the fact that the conductivity measured in this stream on the sampling date was 313 µS/cm which is over three times the requirement specified for a Freshwater Pearl Mussel stream. Also a pipe culvert upstream of and in close proximity to the confluence of this stream with the river Our is blocking the migration of fish upstream of this.
However as in 2007; there were individuals of Brown Trout downstream of this barrier. As recommended by the LIFE group in 2007, the removal of this barrier would allow the free movement of fish upstream and improve the stream as a habitat for Brown Trout (Thielen *et al.*, 2007).

4.4 Jansschleederbaach

Prior to 2006 a migration barrier was present downstream of the stretch (IV/2). Following this the LIFE group reported each size class as very under represented. This has improved significantly without the intervention of local anglers. The 0+ class contains a high number of individuals whereas the 1+ category is less well represented. This will require time to allow the population to stabilise naturally.

4.5 Roupelsbaach

The Roupelsbaach is a relatively small stream and is a tributary of the Jansschleederbaach. The total catch was very low in this stream when compared to other streams. The removal of the pipe culvert has showed a steady increase in the number of fish in the system. It appears that fish are actively spawning here therefore the recovery of the stream as a suitable habitat for Brown Trout has been successful so far.

4.6 Feierbech

The migration of fish in the Feierbech is being inhibited by the presence of a pipe culvert and may be a major factor to the fact that no fish were caught in the stream. However the suitability of the stream as a spawning habitat is questionable as the stream is reported to run dry during summer months with low precipitation (Thielen *et al.*, 2007; Armand Dichter pers. comm). The water quality of the Feierbech has improved dramatically with the installation of the wastewater treatment facility at Tintesmühle. The water quality in the stream is not of the standard of the tributary of a Freshwater Pearl Mussel stream. The measurements taken by the LIFE group shows that the levels of nitrate and conductivity are both elevated but the water quality is of a worse standard in the Schelsbaach.

4.7 Hengeschterbaach

The Hengeschterbaach is in a state of recovery and although the results of this fish population monitoring is significantly poorer than other streams in the project area, it is excellent when previous results are taken into consideration. Bullhead (*Cottus gobio*) was not found during the sampling. This does not prove that it is not present in the stream system but perhaps the recovery of this species will take a longer period of time. The re-stocking programme of Brown Trout is an unnatural recovery method and is therefore affecting the validity of the current results. This population of Brown Trout must be monitored closely in the future in order to confirm that it is in fact self-sustaining.

4.8 Stroumbaach and Kenzelbaach

The Stroumbaach and the Kenzelbaach were both stocked by local anglers with Brown Trout in the 0+ category. This artificial re-stocking is undoubtedly affecting the results collected by the LIFE group in both of these streams. The presence of larger fish in the stream which could have been migrating shows that each of these streams could be important spawning grounds. Further monitoring is required in order to ascertain the self-sustaining nature of these streams.

4.9 Ruederbaach

The Ruederbaach is a very small stream and the population of fish is also relatively small. It is not known why Bullhead (*Cottus gobio*) are not found in this stream. Thielen *et al.* (2007) speculated that a section of the stream with a steep slope upstream of the confluence with the river Our is acting as a natural barrier to the species. The population of Brown Trout has improved significantly with an increase in individuals caught and relative biomass by over 50%.

4.10 Etschenderbaach

The population of Brown Trout in the Etschenderbaach was one of the poorest in the project area. In early 2007 a barrier to migrating fish was removed and the sample taken by the LIFE group after this showed a total of 18 individuals recorded. This has decreased to 12 in 2008 and there is no explanation available for this. It could be just a natural fluctuation and further monitoring will have to be carried out in order to ascertain a long term view of the recovery of this stream. *Cottus gobio* was not previously recorded in this stream but they may recolonise this system in the future.

4.11 River Our

The most abundant species is the Minnow (*Phoxinus phoxinus*). This is good as it is a host for the Freshwater Mussel (*Unio Crassus*). The number of Brown Trout (*Salmo trutta fario*) progressively decreased over the three year period. Very few individuals were from the 0+ category showing that the tributaries act as nurseries for the juveniles of this species. The trend of decreasing numbers of individuals in many species is evident from the results and is shared by Spirlin (*Alburnoides bipunctatus*) and Gudgeon (*Gobio gobio*). The time of year or simply probability may have affected this. The future monitoring of fish population dynamics in the river Our will be able to explain this phenomenon further.

4.12 Overall view

The overall view of the fish population in all of the streams is of improvement due to the actions of the LIFE group. Significant advances in the health status in the Jansschleederbaach, Roupelsbaach and Hengeschterbaach are visible due to the removal of migratory barriers. As a result of this the average biomass per hectare has increased from 36.8 kg per hectare to 63.7kg per hectare. In fact significant improvements are evident from each stream including the Reibaach which was categorised as of good status in 2007. Brown Trout are now beginning to recolonise these streams but barriers to this movement still remain in the Nivelsbaach, Schelsbaach and Feierbech The Etschenterbaach is the only stream where a significant decrease in population is evident. The results of electro-fishing sampling will show if the progress of recovery in this stream is sufficient.

The practical achievements of the LIFE group and other related projects such as INTERREG III A-Program (NatOur) have resulted in significant improvements of the fish population of many streams in northern Luxembourg. The construction and maintenance of wastewater treatment facilities by the water management department has also contributed to this ongoing work. The previous scientific monitoring of these streams by electro-fishing in 2007 and the repeat sampling in 2008 allow for a measurement of population recovery and analysing the relative health in each tributary of the river Our. The sampling of the fish population in the river Our between 2008 and 2010 showed a trend of decreasing numbers for many of the species. This may not be the actual case and future monitoring actions will enable a better scientific overview of this population to be established. This scientific monitoring is very important and is necessary for the future in order to protect and conserve these valuable habitats.

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