Distribution and densities of juvenile salmon and trout in the rivers Iskuras-, Bais-, Leva-, Borse- and Laksjohka in 2010

Working report
31.5.2011

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GAME AND FISHERIES RESEARCH

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1. Introduction

The River Teno (Tana in Norwegian) is located in northern Scandinavia and it forms the border of northern Finland and northern Norway. The river runs via Tanafjord into the Barents Sea (Fig. 1). The Teno river system (drainage area 16386 km^2) is one of the most important Atlantic salmon, *Salmo salar* L., rivers in the world with annual in-river catches up to 250 t and more than 1200 km of rivers accessible to migrating adult salmon. The river system supports at least 20 genetically differentiated salmon populations in the main stem and in its tributaries (Vähä et al., 2007, 2008). The salmon production of the River Teno is entirely dependent on natural reproduction; release of reared fish and eggs is forbidden.

The salmon stocks of the River Teno system are monitored annually by the Finnish Game and Fisheries Research Institute (FGFRI) in close co-operation with Norwegian institutions and authorities. The long-term monitoring programmes includes estimation of the salmon catch, electrofishing for assessment of salmon parr densities in nursery habitats, and collection of adult salmon scale samples to determine the sea-age distribution and growth of salmon and their origin (wild/reared). Spatial coverage of the annual monitoring programme is rather wide, including the Teno mainstem and two large tributaries (Inarijoki and Utsjoki, Fig. 1). However, in this large river system, considerable portion of the production areas have not been monitored intensively during the last decades, including e.g. the small tributaries flowing to Teno mainstem from the Norwegian side.

In august 2010 FGFRI and Fylkesmannen i Finnmark (FF) agreed that FGFRI will conduct electrofishing surveys in five Norwegian tributaries of the River Teno, including river Iskuras-, Bais-, Leva-, Borse- and Laksjohka (Fig. 1). The aim of the electrofishing surveys was to update the status of juvenile fish production (salmon and trout) and to estimate the distribution area of salmon within the tributaries.

This working report presents results from the electrofishing surveys conducted in the rivers Iskuras-, Bais-, Leva-, Borse- and Laksjohka in 2010. Corresponding information from the mainstem Teno and its large tributaries, as well as data from the River Näätämöjoki (Neidenelva, Finnish side), are also presented for comparison.

2. Material and methods

2.1. Electrofishing procedure

The electrofishing surveys were conducted by a three-person team with generator-powered equipment (Hans Grassl GmbH, ELT 60II GI) using pulsed direct current (700-800 V, 0.2 A). In each study site one member of the fishing crew used the anode and two persons collected the stunned fish with dipnets (Fig. 2).

Most of the electrofishing sites were fished by one removal sampling to enable larger number and wider coverage of sampling sites compared to the traditional three pass method. In this report the fish densities are therefore expressed as catches of juveniles on one pass/100 m^2.

Electrofishing sites in each river were selected to represent running water habitats, different types of rapids and glides, in an approximately same proportion as they are found in the river systems. In total 48 separate sites were electrofished. The electrofishing surveys were conducted in 31.8.-24.9.2010 in good (e.g. water level) and stable environmental conditions.

Caught salmon juveniles were classified to three different age categories, including 0+ (fry), 1+ and ≥2+ parr. Trout catch was not age-classified.

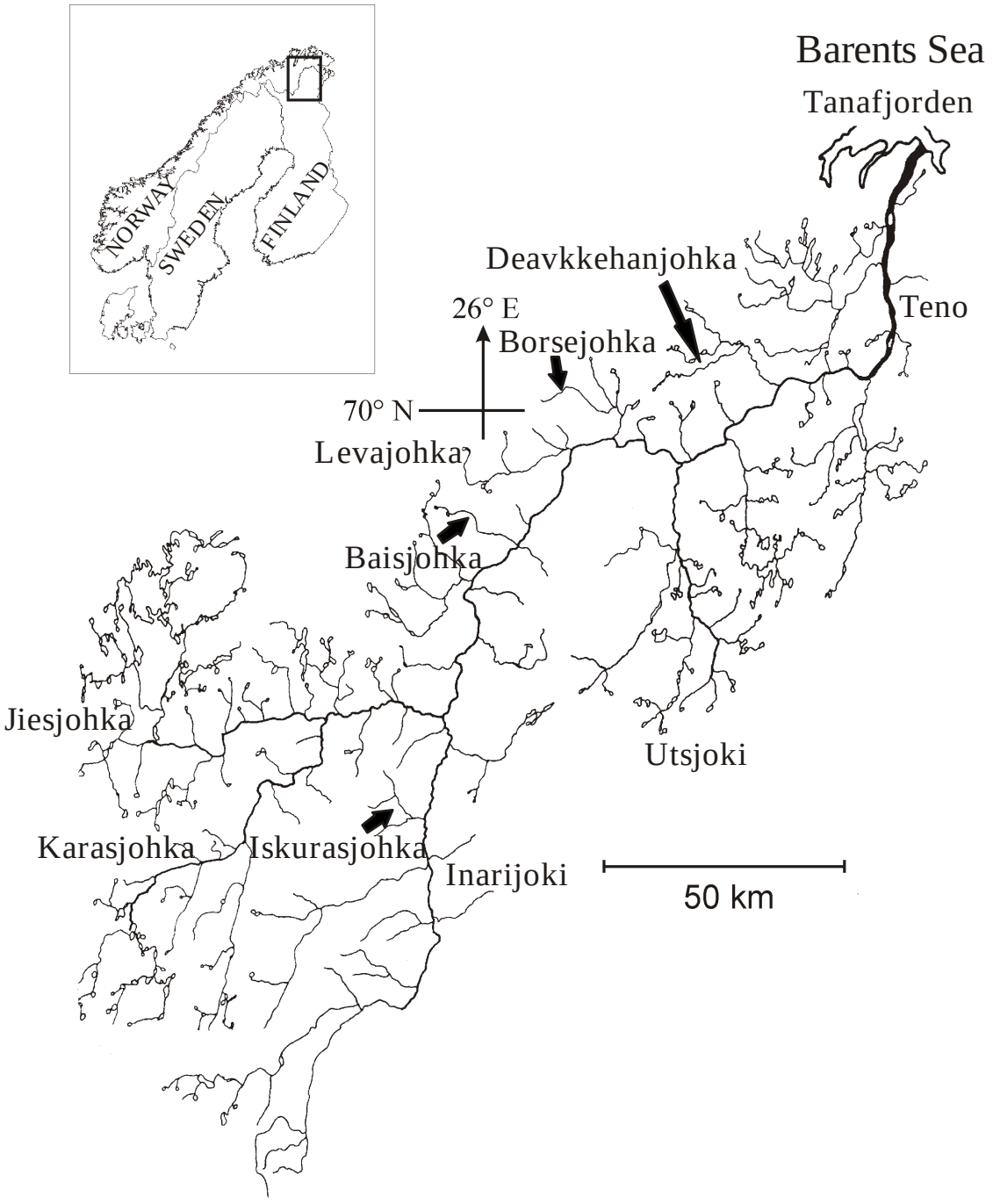

Figure 1. Map of the River Teno system including the Norwegian tributaries where electrofishing surveys were conducted in 2010.

Figure 2. The electrofishing surveys in the tributaries of the River Teno were conducted by a three person team, including the user of the anode and two persons collecting the stunned fish with dipnets. Photo: A. Mäki-Petäys.

2.2. Electrofishing sites

In the River Iskurasjohka 11 sites were electrofished in 14.-16.9.2010 (Figure 3, Appendix 1). The size of the sites varied between 50-169 m^2 (mean 94 m^2). The uppermost site (site 3) was situated c. 13,4 km upstream from the river mouth.

In the River Baisjohka 12 sites were electrofished in 31.8.-3.9.2010 (Figure 4, Appendix 1). The size of the sites varied between 65-141 m^2 (mean 101 m^2). The uppermost site (site 6) was situated c. 17,0 km upstream from the river mouth.

In the River Levajohka 12 sites were electrofished in 7.-10.9.2010 (Figure 5, Appendix 1). The size of the sites varied between 73-200 m^2 (mean 118 m^2). The uppermost site (site 5) was situated c. 13,6 km upstream from the river mouth.

In the River Borsejohka 3 sites were electrofished in 7.9.2010 (Figure 6, Appendix 1). The size of the sites varied between 65-100 m^2 (mean 75 m^2). The uppermost site (site 3) was situated c. 1,9 km upstream from the river mouth.

In the River Deavkkehanjohka 10 sites were electrofished in 20-23.9.2010 (Figure 7, Appendix 1). The size of the sites varied between 47-130 m^2 (mean 82 m^2). The uppermost site (site 1) was situated c. 24,0 km upstream from the river Laksjohka mouth.

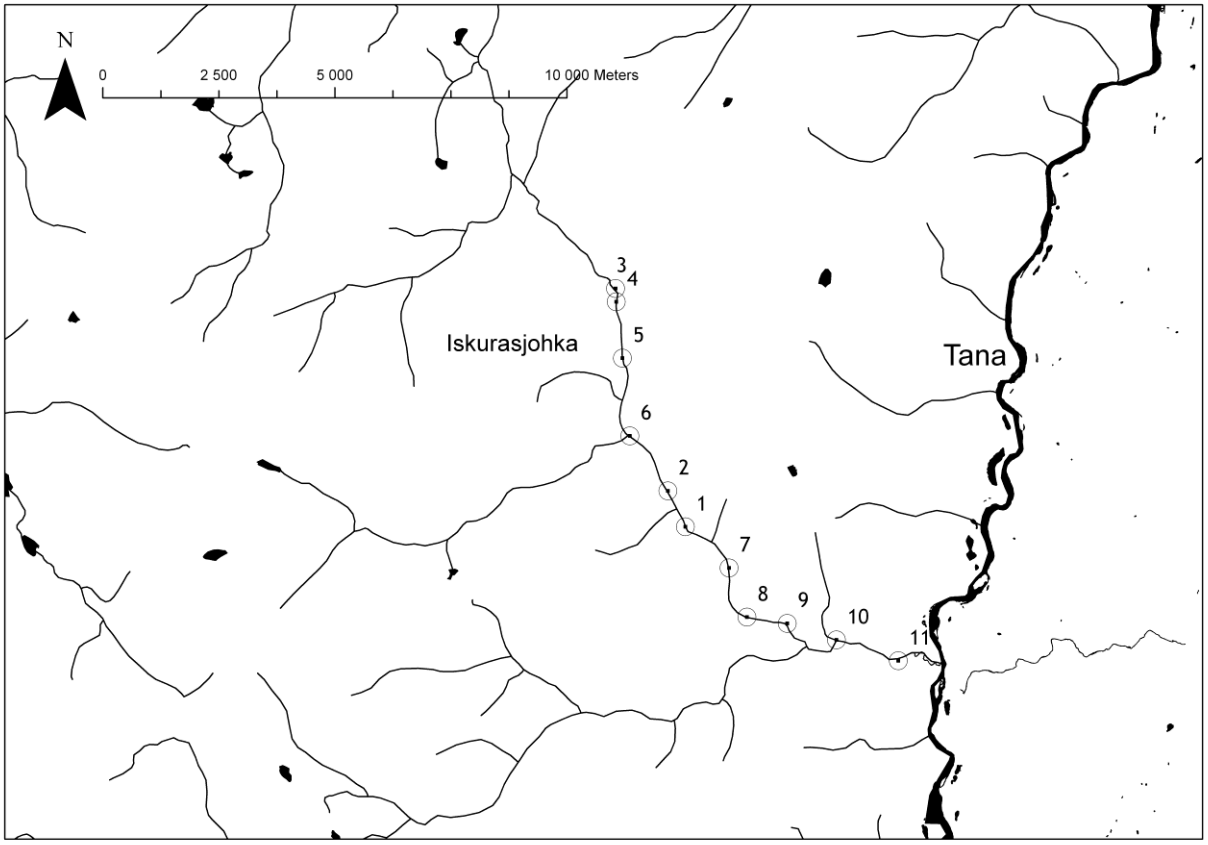

Figure 3. The location and numbering of electrofishing sites in the River Iskurasjohka in 2010. Individual electrofishing site coordinates (UTM 35) can be found from appendix 1.

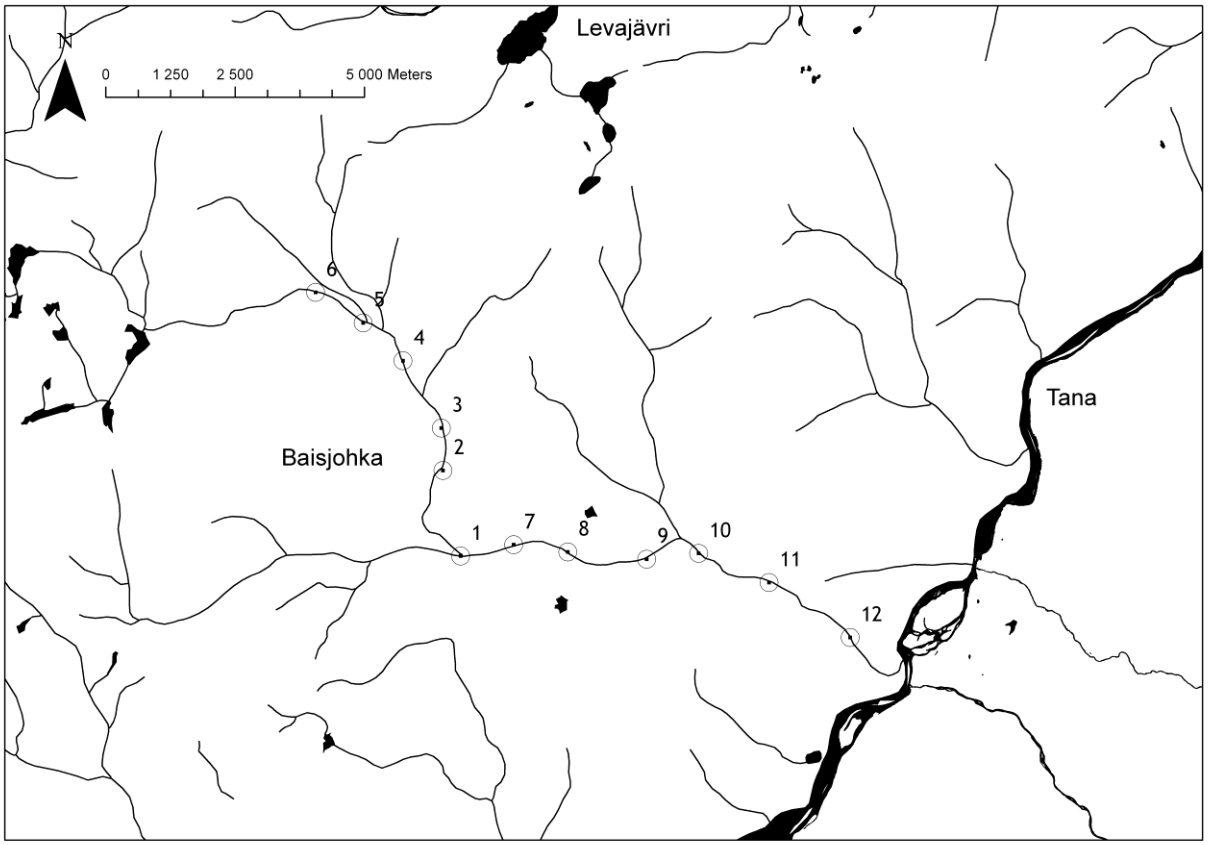

Figure 4. The location and numbering of electrofishing sites in the River Baisjohka in 2010. Individual electrofishing site coordinates (UTM 35) can be found from appendix 1.

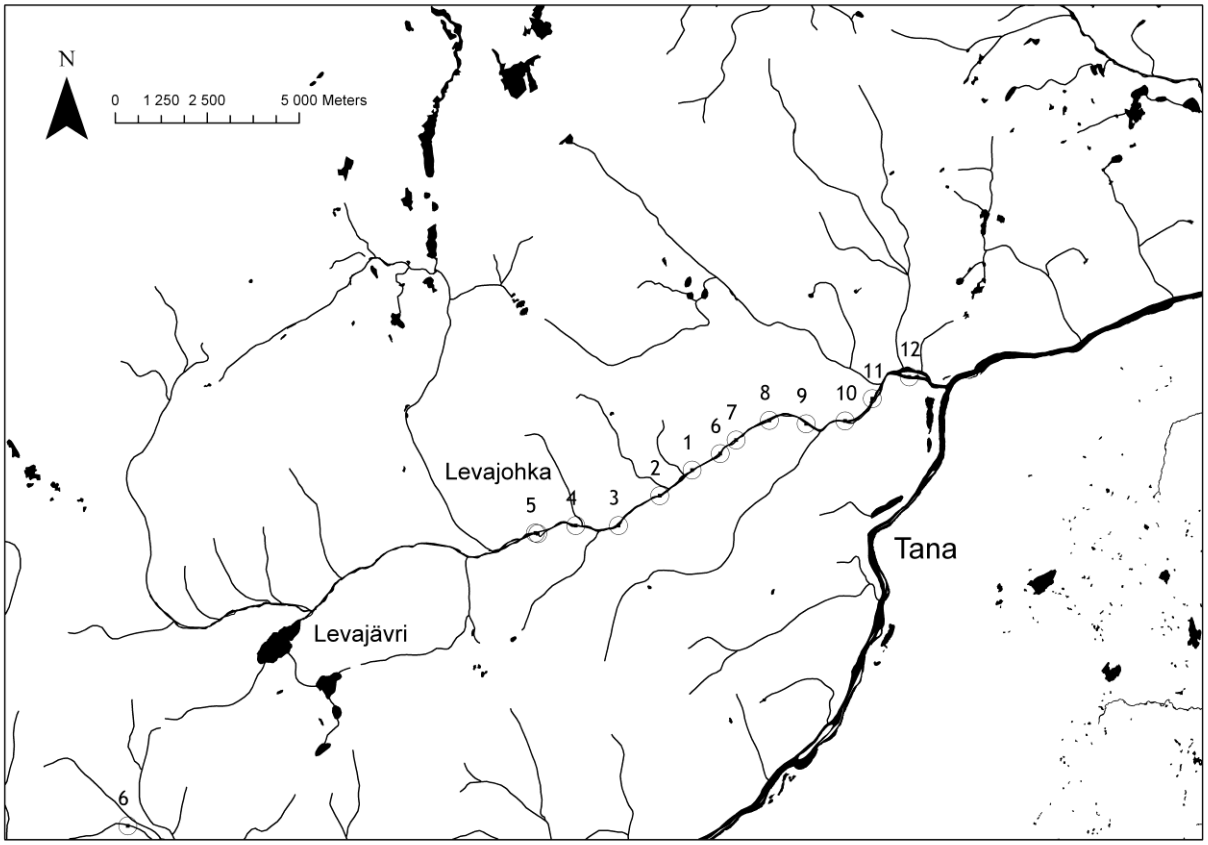

Figure 5. The location and numbering of electrofishing sites in the River Levajohka in 2010. Individual electrofishing site coordinates (UTM 35) can be found from appendix 1.

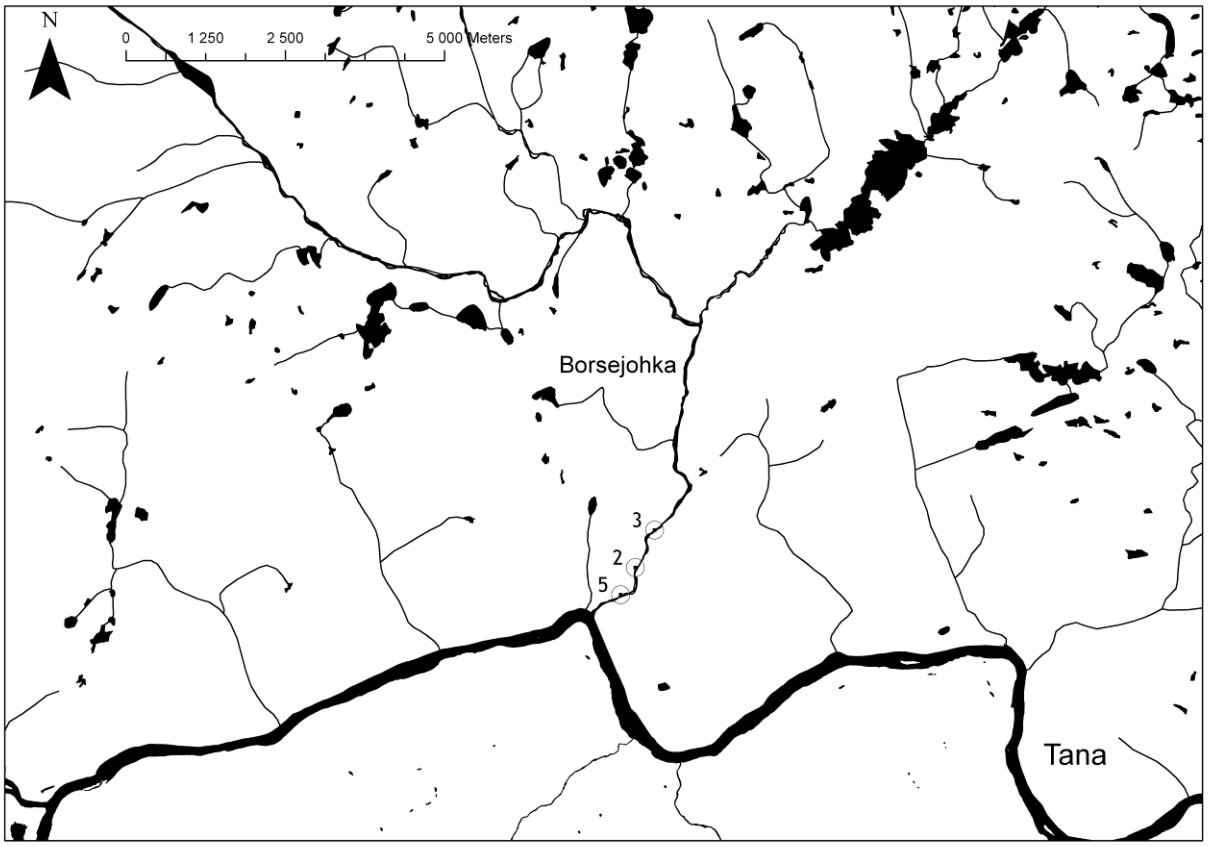

Figure 6. The location and numbering of electrofishing sites in the River Borsejohka in 2010. Individual electrofishing site coordinates (UTM 35) can be found from appendix 1.

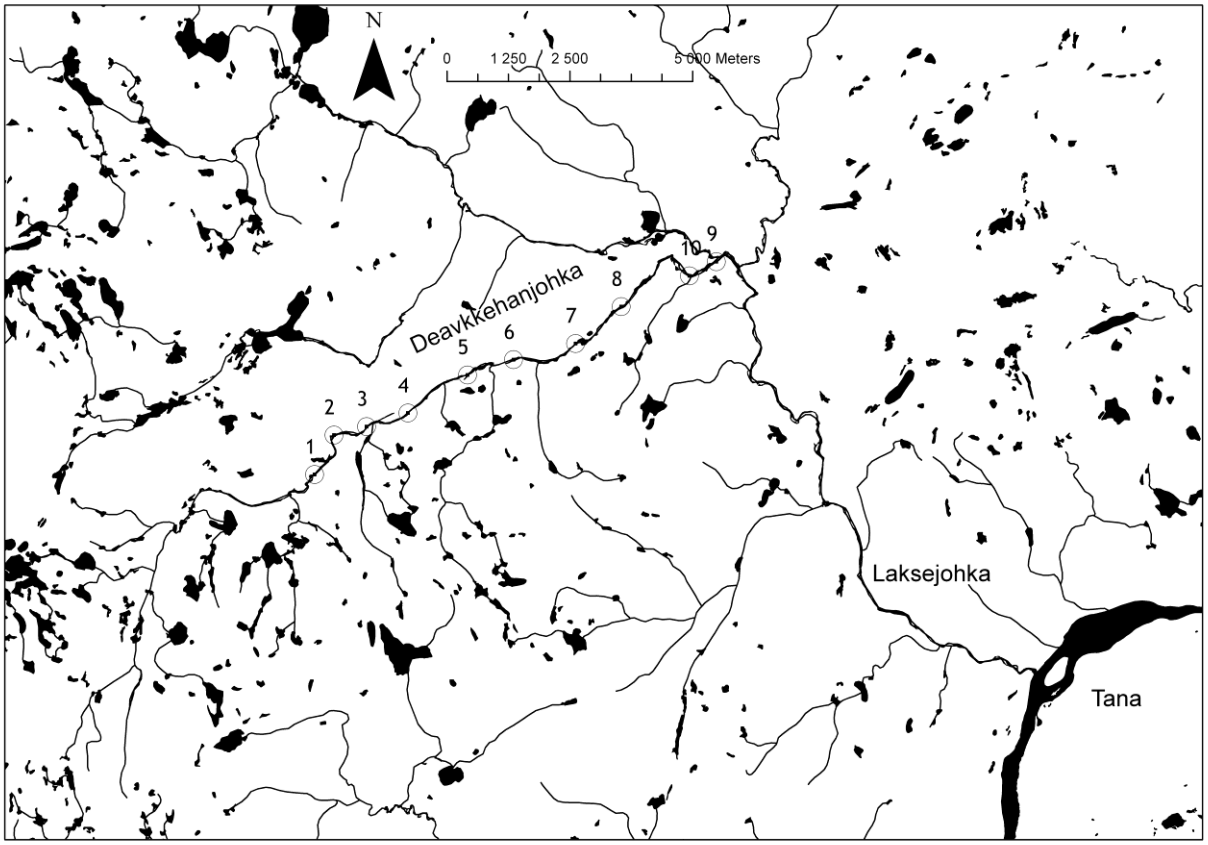

Figure 7. The location and numbering of electrofishing sites in the River Deavkkehanjohka in 2010. Individual electrofishing site coordinates (UTM 35) can be found from appendix 1.

3. Results

3.1. Iskurasjohka

Salmon juveniles were found from 9 out of 11 electrofishing sites in the River Iskurasjohka (Fig. 8). No salmon juveniles were found from the sites 3-4, which were situated at the uppermost end of the study area, c. 13,4 km upstream from the river mouth.

Salmon fry (0+) were caught from 7 electrofishing sites and the density varied between 1,1 and 25,3 individuals/100 m^2 with density peaking at site number 9 (Fig. 8). The mean fry density was 4,1 individuals/100 m^2.

Salmon parr of age 1+ were found from 8 electrofishing sites. The 1+ parr density exceeded 15 ind./100 m^2 in three sites and the mean density was 6.1 fish/100 m^2 (Fig. 8). Older salmon parr ($\geq$2+) mean density was 5,2 ind./100 m^2 with density peaking at site nro. 11 close to the river mouth (Fig. 8).

Trout juveniles were caught from all sites, except the site nro. 11 at the river mouth (Fig. 8). The trout density varied between 1,1 and 17,5 ind./100 m^2 with a mean density of 7,1 fish/100n m^2.

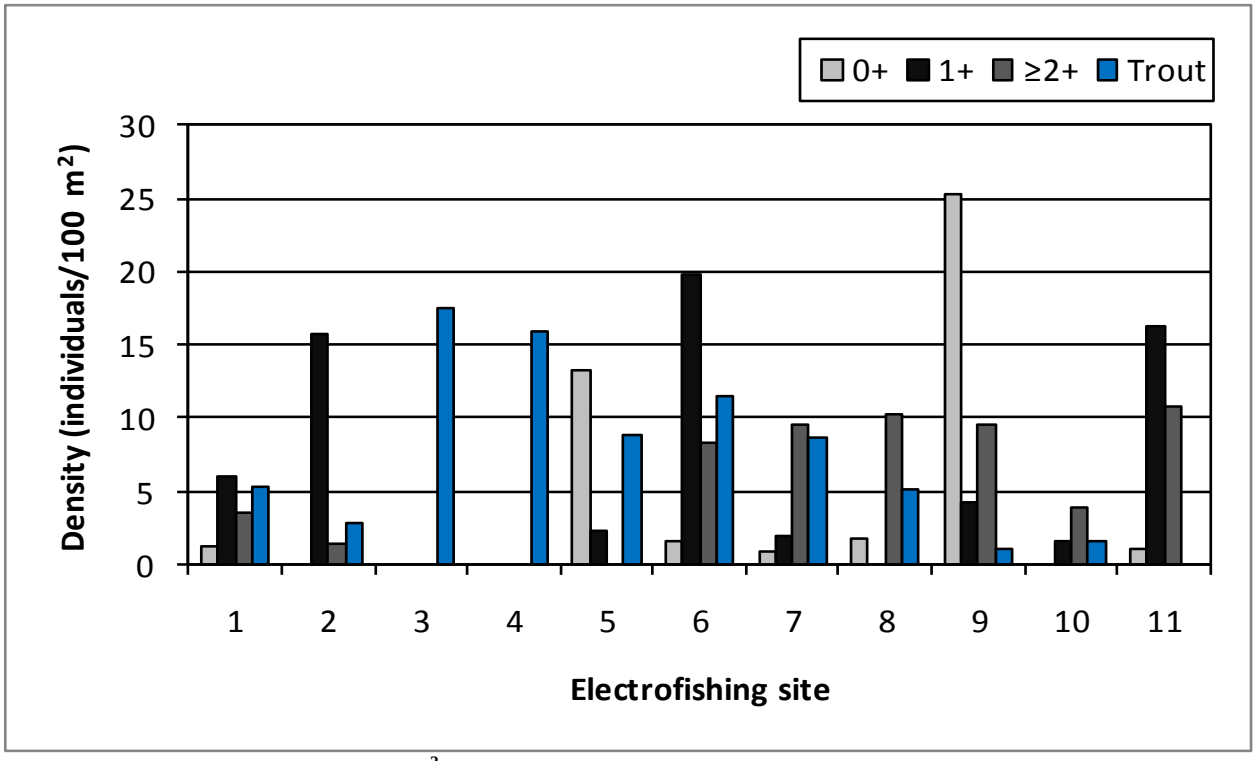

Figure 8. Densities (individuals/100 m^2, one pass electrofishing) of 0+, 1+ and ≥2+ salmon and trout parr in the River Iskurasjohka in 2010.

3.2. Baisjohka

In the River Baisjohka salmon juveniles were found from all the electrofishing sites, but trout juveniles only from site 3 (Fig. 9). Salmon fry (0+) were found from the uppermost electrofishing area (site 6) which indicates that practically the whole river length is used for reproduction by salmon (see Fig. 4).

Salmon 0+ densities were generally low, varying between 1,0 and 9,0 ind./100 m^2. The mean fry density was only 2,1 ind./100 m^2.

Older salmon parr (1+ and ≥2+ parr) densities were highest in the upper reaches of the study area (sites 1-6) (Figs. 4 and 9). The densities of 1+ parr varied between 1,5 and 24,5 fish/100 m^2 (mean density 6,9 ind./100 m^2) and those of ≥2+ parr between 3,6 and 19,4 ind./100 m^2 (mean density 9,1 ind./100 m^2).

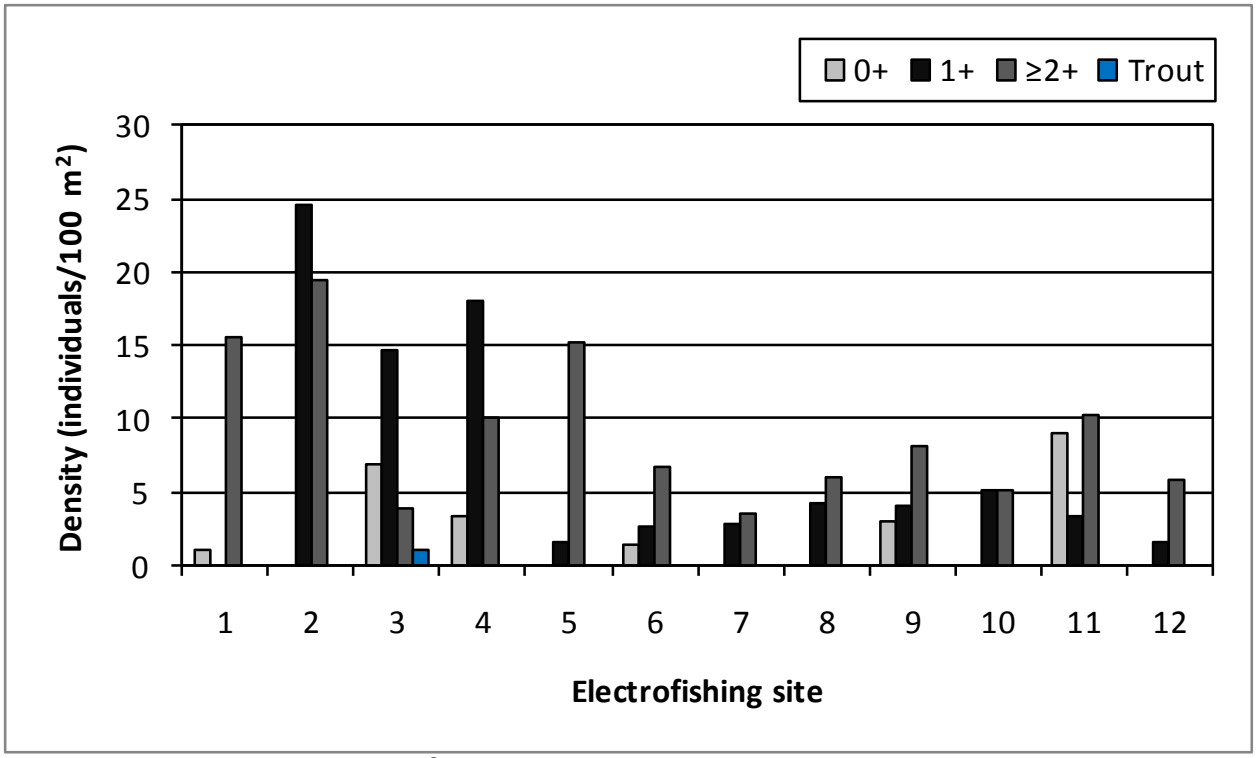

Figure 9. Densities (individuals/100 m^2, one pass electrofishing) of 0+, 1+ and ≥2+ salmon and trout parr in the River Baisjohka in 2010.

3.3. Levajohka

Salmon juveniles were present in all the electrofishing sites of the River Levajohka, but in fairly low densities (Fig. 10). No obstacles for salmon migration were found below the uppermost electrofishing site and based on aerial photos significant obstacles above the uppermost site are not present. Thus, the whole river length up to the Lake Levajävri is potential area for juvenile production of salmon.

Although salmon juveniles were found from all the studied areas, salmon fry (0+) were present in only one site (site nr. 1, Fig. 10). The mean fry density of the 12 electrofishing sites was therefore only 0,3 ind./100 m^2.

Salmon 1+ parr densities varied between 1,0 and 28,7 ind./100 m^2, the highest density observed in the lowermost electrofishing site, close to the river mouth (Fig. 10). Mean 1+ parr density was 5.3 ind./100 m^2.

Older (≥2+) salmon parr densities varied between 1,0 and 26,0 ind./100 m^2, and as with 1+ parr the highest density was observed at site 12 (Fig. 10). Mean density of ≥ 2+ parr was 8,4 ind./100 m^2.

Trout juveniles were found from three sites at lower reaches of the river (Fig. 10). The trout juvenile density varied between 0,6 and 2,7 ind./100 m^2 and the mean density was 0,4 ind./100 m^2.

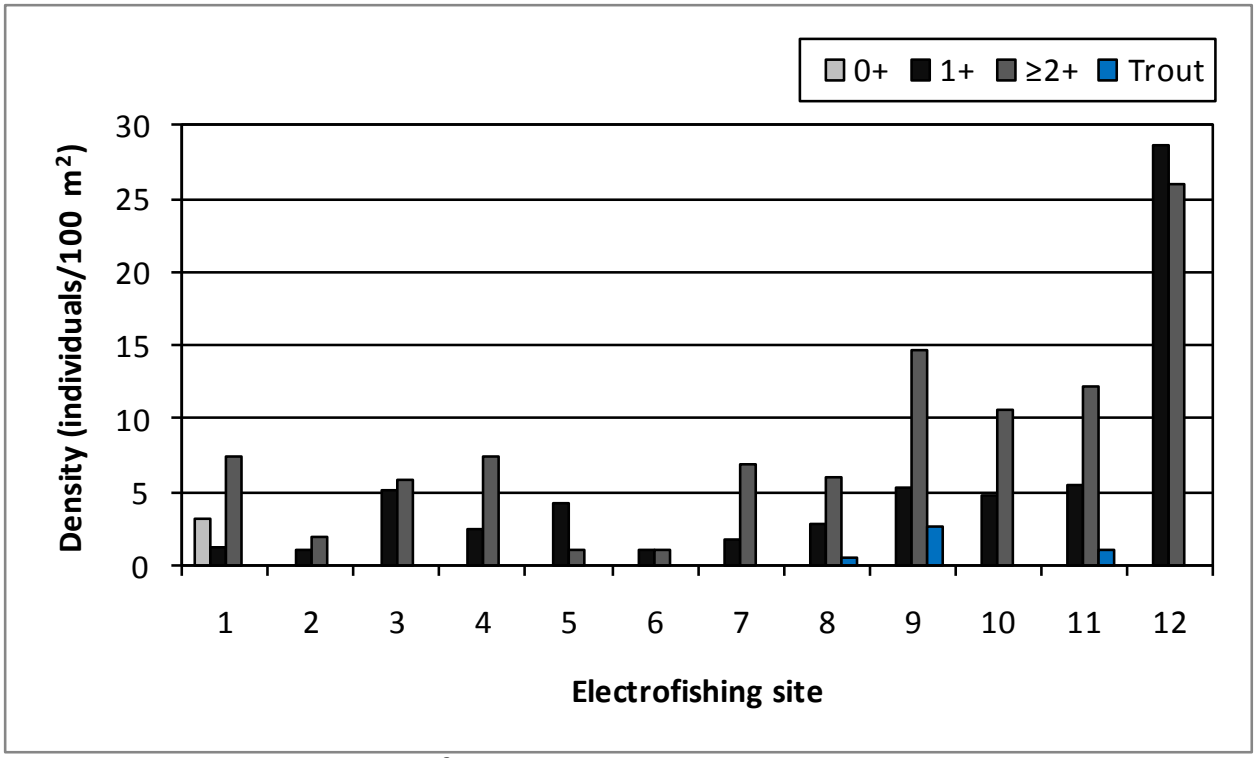

Figure 10. Densities (individuals/100 m^2, one pass electrofishing) of 0+, 1+ and ≥2+ salmon and trout parr in the River Levajohka in 2010.

3.4. Borsejohka

The river Borsejohka is a very steep river and its substrate is dominated by large boulders and stones. Only one salmon juvenile (≥2+ parr, site 5) were found from the three surveyed sites (Fig. 11). On the other hand, trout juveniles were present in all three sites with a mean density of 3,5 ind./100 m^2 (Fig. 11).

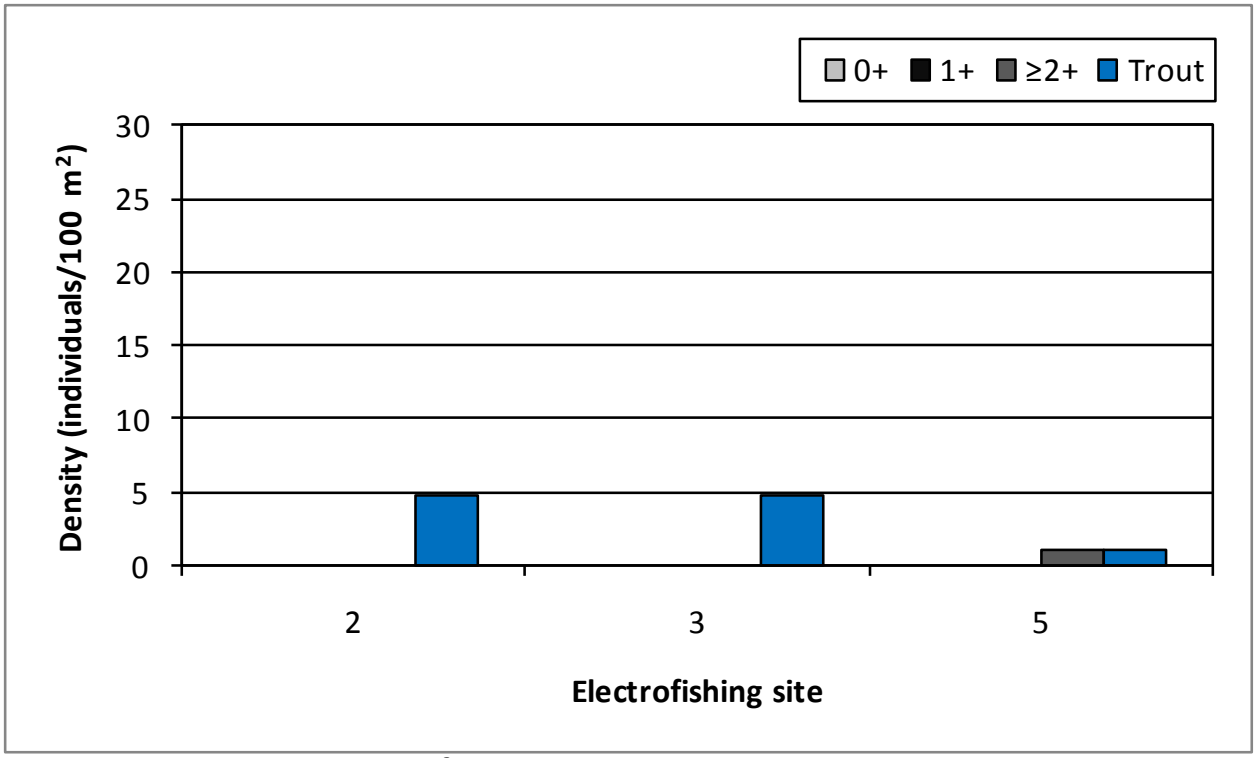

Figure 11. Densities (individuals/100 m^2, one pass electrofishing) of 0+, 1+ and ≥2+ salmon and trout parr in the River Borsejohka in 2010.

3.5. Deavkkehanjohka (Laksjohka)

Juvenile salmon were found from all the electrofishing sites in the River Deavkkehanjohka, which is an important tributary of the river Laksjohka (Fig. 12). The densities of salmon juveniles were, however, rather low (Fig. 12). In general, the densities were higher in the upper reaches of the study area (sites 1-4, Fig. 12) and it is clear that juvenile salmon production areas continue significantly upstream from the uppermost electrofishing site.

Salmon fry (0+) were present in six electrofishing sites and densities varied between 1,2 and 10,1 ind./100 m^2 (Fig. 12). The 0+ density peaked at the site 2, situated at the upper reaches of the study area (see Fig. 7). Mean fry density was 2,2 ind./100 m^2.

Salmon 1+ parr were found from eight sites and their density varied between 1,9 and 6,9 ind./100 m^2 (Fig. 12). Mean density of the 10 surveyed sites was 2,9 ind./100 m^2. Older (≥2+) parr were present also in the same sites than 1+ parr and their density varied between 5,2 and 22,4 ind.100 m^2(mean density 11,1 ind./100 m^2) (Fig. 12).

Juvenile trout were caught from four sites situated at the lower reaches of the study area (Fig. 12). Trout densities varied between 1,0 and 3,5 ind./100 m^2.

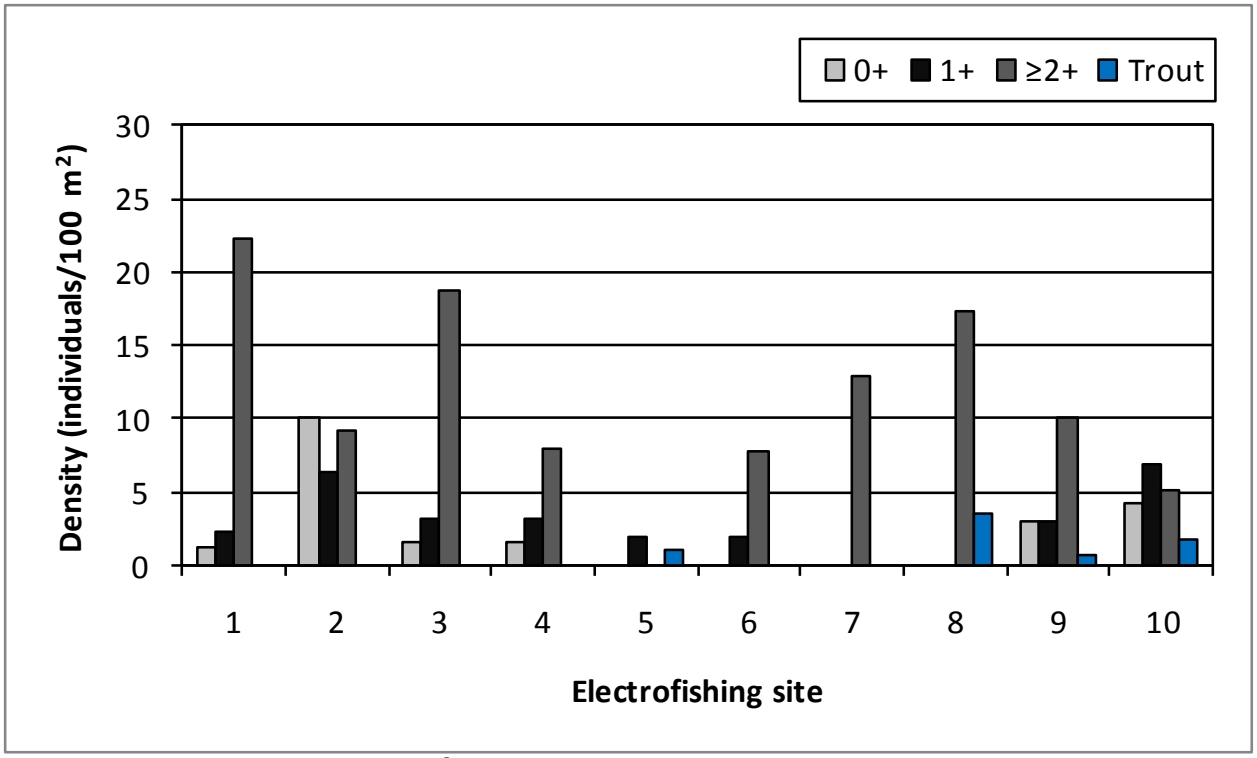

Figure 12. Densities (individuals/100 m^2, one pass electrofishing) of 0+, 1+ and ≥2+ salmon and trout parr in the River Deavkkehanjohka in 2010.

3.6. Density levels as compared to other rivers

Based on the electrofishing surveys conducted in the small tributaries of the River Teno, both on Finnish and Norwegian side, the 0+ juvenile mean densities were extremely low (Table 1). E.g. in the River Akujoki (flowing to River Teno on Finnish side c. 185 km upstream from the river mouth) the 0+ mean densities has varied between 8,0 and 28,4 ind./100 m^2 during 2004-2009 and at the same time in the River Pulmankijoki, the mean densities of 0+ salmon have varied between 7,4-23,3 ind./100 m^2 (Orell, unpublished data). Information from other small tributaries from last few years has also indicated significantly higher (8,0-34,9 ind./100 m^2) mean 0+densities than was observed in the tributary surveys in 2010.

There was also a very clear difference in 0+ mean densities when compared to densities observed in larger rivers, e.g. in the Teno main stem, Inarijoki main stem and Utsjoki main stem (Table 1). In the Finnish part of the River Neiden 0+ mean densities were at a rather low level and almost comparable to the levels observed in the small tributaries of Teno (Table 1).

The mean densities of 1+ salmon parr were rather similar in most of the small tributaries (excluding the river Borsejohka), but again higher mean densities were observed in the rivers Teno and Inarijoki main stems (Table 1). Overall, the mean densities of 1+ parr were low, e.g. when compared to the mean densities observed in the rivers Akujoki and Pulmankijoki in 2004-2009 (Akujoki: 8,9-17,7 ind./100 m^2; Pulmankijoki: 3,8-15,6 ind./100 m^2).

Mean densities of ≥2+ parr peaked in the tributaries Deavkkehanjohka and Kuoppilasjohka. In other areas the mean densities were roughly in a same level, when excluding the River Borsejohka (Table 1). The mean densities of the ≥2+parr were not higher in the main stems of the rivers Teno, Inarijoki and Utsjoki when compared to the densities observed in the small tributaries (Table 1). Overall, the mean densities of ≥2+ parr were in a level observed in Pulmankijoki in 2004-2009 (4,8-

8,0 ind./100 m^2) and slightly lower than in Akujoki during the same time period (11,7-17,1 ind./100 m^2).

Table 1. The mean densities of 0+, 1+ and ≥2+ salmon parr per 100 m^2 in different part of the River Teno and River Neiden in 2010. Densities are based on one pass electrofishing.

River	Country	n (sites)	0+	1+	?2+	Total
Iskurasjohka	Nor	11	4,1	6,1	5,2	15,4
Baisjohka	Nor	12	2,1	6,9	9,1	18,1
Levajohka	Nor	12	0,3	5,3	8,4	14,0
Borsejohka	Nor	3	0,0	0,0	0,3	0,3
Deavkkehanjohka	Nor	10	2,2	2,9	11,1	16,2
Nilijoki	Fin	13	3,4	5,9	6,7	15,9
Kuoppilasjoki	Fin	17	1,7	5,3	12,2	19,2
Teno main stem	Nor/Fin	32	14,5	11,4	6,5	32,4
Inarijoki main stem	Nor/Fin	9	16,7	10,2	7,6	34,5
Utsjoki main stem	Fin	12	13,7	5,6	7,6	26,9
Neiden	Fin	17	6,9	5,1	6,1	18,1

4. Conclusions

The electrofishing survey results indicates that juvenile salmon inhabits and adult salmon spawns in all the surveyed rivers, except the River Borsejohka. In the rivers Baisjohka, Levajohka and Deavkkehanjohka salmon juveniles were present in the most upstream study areas and this reveals that salmon is practically utilizing the whole available production areas in these tributaries.

In the River Levajohka, however, salmon 0+ juveniles were only found from one electrofishing site. This might imply that the survey sites were non-representative for 0+ salmon, that the major spawning areas are actually situated upstream from the surveyed sites (>14 km from the river mouth) or that the rivers salmon spawning stock is very limited. The first explanation is not likely, as the survey included 12 electrofishing sites, which were chosen to represent different habitat types (as in other tributaries) found in the surveyed area. Based on long-term experience, several potential 0+ salmon habitats were electrofished in Levajohka.

The overall low 0+ densities in all of the surveyed tributaries were somewhat surprising. The salmon spawning stocks (mainly 1SW salmon) were rather weak in 2009 as revealed by underwater video monitoring and snorkelling studies conducted in several tributaries of the River Teno. This may partly explain the low 0+ densities observed in 2010. However, significantly higher mean 0+ densities have been observed earlier in the small tributaries of the River Teno, even though the spawning stock sizes have been as low as or even lower than in 2009. This might indicate that the riverine environmental conditions (e.g. floods and ice-break up) after spawning have been challenging for the eggs and fry and that the mortality rates have been higher than normally.

In contrast to the 0+ densities the densities of larger (≥1+ parr) parr were significantly higher. Parr were also found from most of the surveyed electrofishing sites. This indicates that salmon production is temporally and spatially frequent in the surveyed tributaries (excluding the River Borsejohka). Inter-annual fluctuations can, however, be very large as indicated by the low 0+ densities observed in 2010. Overall, the salmon populations of the small tributaries are sensitive both to environmental and human-induced (e.g. fishing) disturbances.

Trout juveniles were found from all the surveyed five tributaries. However, only in the River Iskurasjohka trout densities were considerable and individuals were present in most of the surveyed sites. This observation indicates that, excluding the River Iskurasjohka, salmon is the prevalent species in the main stems of the surveyed tributaries. The densities and proportion of trout compared to salmon are probably higher in the small brooks flowing to the surveyed tributaries, as observed e.g. in some tributaries on Finnish side.

References

Vähä, J-P., Erkinaro, J., Niemelä, E. & Primmer, C. R. 2007. Life-history and habitat features influence the within-river genetic structure of Atlantic salmon. Molecular Ecology 16: 2638-2654.

Vähä, J-P., Erkinaro, J., Niemelä, E. & Primmer, C. R. 2008. Temporally stable genetic structure and low migration in an Atlantic salmon population complex: implications for conservation and management. Evolutionary Applications 1: 137–154.

Appendixes

Appendix 1. Coordinates (WGS84, UTM 35) of the surveyed electrofishing sites in the river Iskuras-, Bais-, Leva-, Borse- and Deavkkehanjohka in 2010.

River	Electrofishing site	WGS84 UTM35 X	WGS84 UTM35 Y
Iskurasjohka	1	443324	7685083
Iskurasjohka	2	442944	7685859
Iskurasjohka	3	441820	7690218
Iskurasjohka	4	441836	7689932
Iskurasjohka	5	441969	7688716
Iskurasjohka	6	442128	7687043
Iskurasjohka	7	444262	7684198
Iskurasjohka	8	444647	7683138
Iskurasjohka	9	445515	7683002
Iskurasjohka	10	446577	7682646
Iskurasjohka	11	447908	7682196
Baisjohka	1	459888	7742011
Baisjohka	2	459548	7743668
Baisjohka	3	459514	7744488
Baisjohka	4	458775	7745791
Baisjohka	5	458005	7746523
Baisjohka	6	457083	7747112
Baisjohka	7	460914	7742230
Baisjohka	8	461959	7742092
Baisjohka	9	463487	7741951
Baisjohka	10	464490	7742063
Baisjohka	11	465851	7741500
Baisjohka	12	467420	7740436
Levajohka	1	472412	7756781
Levajohka	2	471535	7756085
Levajohka	3	470413	7755277
Levajohka	4	469255	7755273
Levajohka	5	468156	7755071
Levajohka	6	473177	7757228
Levajohka	7	473608	7757598
Levajohka	8	474513	7758132
Levajohka	9	475514	7758044
Levajohka	10	476568	7758120
Levajohka	11	477309	7758725
Levajohka	12	478312	7759313
Borsejohka	2	488547	7762773
Borsejohka	3	488849	7763360
Borsejohka	5	488315	7762346
Deavkkehanjohka	1	506442	7777178
Deavkkehanjohka	2	506836	7777981
Deavkkehanjohka	3	507500	7778154
Deavkkehanjohka	4	508339	7778428
Deavkkehanjohka	5	509552	7779204
Deavkkehanjohka	6	510489	7779514
Deavkkehanjohka	7	511752	7779843
Deavkkehanjohka	8	512680	7780594
Deavkkehanjohka	9	514614	7781510
Deavkkehanjohka	10	514067	7781220