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Spawning target setting

**Panu Orell, Mikko Kytökorpi, Jorma Kuusela, Peder Fiske and  
Jaakko Erkinaro**



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**Aurora**

Our Precious Transboundary Waters

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## Abstract

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The River Nääämöjoki is a significant Atlantic salmon river located in Northern Finland and Norway and runs to Barents Sea via Neidenfjorden. The river sustains important salmon fisheries both at sea and at the river itself. Recently, salmon spawning targets for different parts of the Nääämöjoki were set to enable population specific and target-based management. Spawning targets were set to the known salmon distribution areas of the Nääämöjoki system, but at that time knowledge of salmon distribution from the tributary river Kallojoki (Gálotjohka) was missing.

Salmon distribution of the River Kallojoki was mapped by electrofishing in August 2024. These data together with knowledge from local fishers, habitat information based on field observations and aerial photos were then used to set the spawning target for the Kallojoki salmon.

The electrofishing survey conducted in 2024 proved that considerable salmon juvenile production still occurs in Kallojoki and in its tributary Vuosttamušjohka despite the decreased discharge caused by the water direction to the Gandvik power plant. Salmon juveniles were caught from all the electrofishing sites (n=19) except the site, which was located above a c. 4 m high waterfall in the Kallojoki main stem.

The spawning target of the Kallojoki system was estimated to be rather small, c. 324 000 eggs (180 kg of females). This is partly caused by the fact that part of the Kallojoki production area has been lost due to the lowered discharge. Secondly, very limited spawning habitats and nursery areas for 0+ salmon juveniles are available in the system.

The overall Nääämöjoki spawning target defined in 2022 increased slightly (5814 kg vs. 5634 kg of female salmon) after including the Kallojoki system. The inclusion of the Kallojoki system did not affect the overall spawning target share between Finland and Norway.

**Keywords:** Salmon, *Salmo salar*, distribution, juvenile production, spawning target, electrofishing, River Nääämöjoki

## Tiivistelmä

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Näätämöjoki on merkittävä lohijoki, joka sijaitsee Pohjois-Suomessa ja Norjassa ja laskee Näätämövuonon kautta Barentsinmereen. Joki ylläpitää huomattavaa lohen kalastusta sekä merellä että itse joessa. Vesistön lohikantojen tavoiteperusteisen hoidon tueksi asetettiin muutama vuosi sitten ns. kutukantatavoitteet. Ne määritettiin Näätämöjoen tunnetulle lohen levinneisyysalueelle, mutta tuolloin puuttui tieto Kallojoen lohen levinneisyydestä.

Kallojoen lohien levinneisyyttä kartoitettiin sähkökalastuksin kesällä 2024. Saatuja levinneisyystietoja sekä paikallisten kalastajien tietämystä, kenttähavaintoihin perustuvia elinympäristötietoja ja ilmakuvia käytettiin sitten Kallojoen lohen kututavoitteen asettamiseen.

Toteutettu sähkökalastustutkimus osoitti, että Kallojoella ja sen sivujoella Vuosttamušjohkassa esiintyy edelleen huomattavaa lohenpoikastuotantoa, vaikka Kallojoen vesimäärä on vähentynyt, kun osa sen vesistä on käännetty virtaamaan Gandvikin voimalaitokselle. Lohen poikasia saatiin kaikilta sähkökalastusalueilta (n=19) paitsi yhdeltä, joka sijaitsi Kallojoen pääuomassa n. 4 m korkean vesiputouksen yläpuolella.

Kallojoen vesistön kutukantatavoitteen arvioitiin olevan melko pieni, n. 324 000 mätimunaa (180 kg naaraslohia). Tämä johtuu osittain siitä, että osa Kallojoen tuotantoalueesta on menettänyt alentuneen virtauksen vuoksi. Toiseksi, Kallojoessa rajoittavana tekijänä ovat lisäksi vähäinen lohen kutualueiden ja kesänvanhoille poikasille soveltuvien elinympäristöjen määrä.

Näätämöjoen vesistön kokonaiskutukantatavoite kasvoi hieman (5814 kg vs. 5634 kg naaraslohia), kun Kallojoki lisättiin laskelmiin mukaan. Kallojoen lisääminen ei vaikuttanut kutukantatavoitteiden jakautumiseen Suomen ja Norjan välillä.

**Asiasanat:** Lohi, *Salmo salar*, levinneisyys, poikastuotanto, kutukantatavoite, sähkökalastus, Näätämöjoki

## Sammendrag

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Neidenelva er en betydelig lakseelv som ligger i nordlige deler av Finland og Norge og renner ut i Barentshavet via Neidenfjorden. Elva gir grunnlag for viktige laksefiskerier både i sjøen og i selve elva. Gytebestandsmål for ulike deler av vassdraget har relativt nylig blitt satt, som et grunnlag for forvaltning etter gytebestandsmål. Gytebestandsmålene ble satt ut fra den kjente utbredelsen av laks i Neidenvassdraget, men da målene ble satt var det ukjent i hvor langt laksen gikk i sideelva Gállotjohka (Kallojoki).

Laksen utbredelse i Gállotjohka ble kartlagt ved elektrofiske i august 2024. Elektrofiskedataene ble sammenholdt med kunnskap fra lokale fiskere, samt vurderinger av habitatkvalitet vurdert både ut fra feltobservasjoner og flyfoto. Denne informasjonen ble sammenholdt for å sette gytebestandsmål for laks i Gállotjohka.

Elektrofiskedataene fra august 2024 viste at det er en relativt god produksjon både i Gállotjohka og i sidegreina Vuosttamušjohka, selv om fraføring av vann gjennom Gandvik krafverk har ført til mindre vannføring enn det opprinnelig ville ha vært. Ungfisk av laks ble fanget på alle 19 elfiskestasjoner som ble undersøkt, bortsett fra den ene stasjonen som lå oppstrøms en fire meter høy foss i hovedstrengen til Gállotjohka.

Gytebestandsmålet i Gállotjohka systemet ble estimert til å være relativt lite, ca 324 000 egg noe som gir 180 kg hunnlaks. Dette er delvis på grunn av at noe produksjonsareal har blitt tapt på grunn av mindre vannføring som følge av fraføring av vann, og delvis fordi både gyteområder og oppvekstområder for 0+ lakseunger er begrenset i systemet.

Det totale gytebestandsmålet for Neidenvassdraget økte litt sammenlignet med gytebestandsmålet som ble satt i 2022 (fra 5634 kg til 5814 kg). Fordelingen av gytebestandsmålet på Norske og Finske områder blir ikke endret ved å ta med Gállotjohka i det totale gytebestandsmålet.

**Nøkkelord:** Laks, *Salmo salar*, utbredelse, ungfiskproduksjon, gytebestandsmål, elektrofiske, Neidenelva

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# 1. Introduction

The River Näätamöjoki (Neidenelva in Norwegian, Njauddâm in Skolt Sámi) is a significant Atlantic salmon river located in Northern Finland and Norway and runs to Barents Sea via Neidenfjorden. The river sustains important salmon fisheries both at sea and at the river itself. Management of the salmon populations of the River Näätamöjoki is based on a bilateral fishing agreement between the countries. The current agreement is old (1979-1984) and negotiations to renew it were started in 2024. Different activities of the Atlantic salmon monitoring program at the Näätamöjoki system have produced time-series data dating back to 1970 and 1980s (Kytökorpi et al. 2024)

Recently, salmon spawning targets for different parts of the Näätamöjoki were set to enable population specific and target-based management (Orell et al. 2022). Spawning target is the biomass of female salmon needed to attain the freshwater carrying capacity of a river system (Forseth et al. 2013). Spawning targets were set to the known salmon distribution areas of the Näätamöjoki system, but at that time knowledge of salmon distribution from the tributary river Kallojoki (Gállotjohka) was missing.

The Kallojoki system has been the last tributary without updated information on its salmon population, distribution and production areas. The river itself has also experienced significant changes in local conditions as part of its catchment area has been directed to a different watershed to promote hydropower production at the Gandvik powerplant (Niemelä et al. 2018). Knowledge of the salmon distribution in the Kallojoki as a significant part of the Näätamöjoki catchment is important and needed to manage and conserve its salmon population.

Salmon distribution of the River Kallojoki was mapped by electrofishing in August 2024. These data together with knowledge from local fishers, habitat information based on field observations and aerial photos were then used to set the spawning target for the Kallojoki salmon.

This report presents the methods and main results of the electrofishing survey and the estimated spawning target. The work was done as part of the bilateral project the "Our Precious Transboundary Waters" which was funded by the European Union Interreg Aurora program.

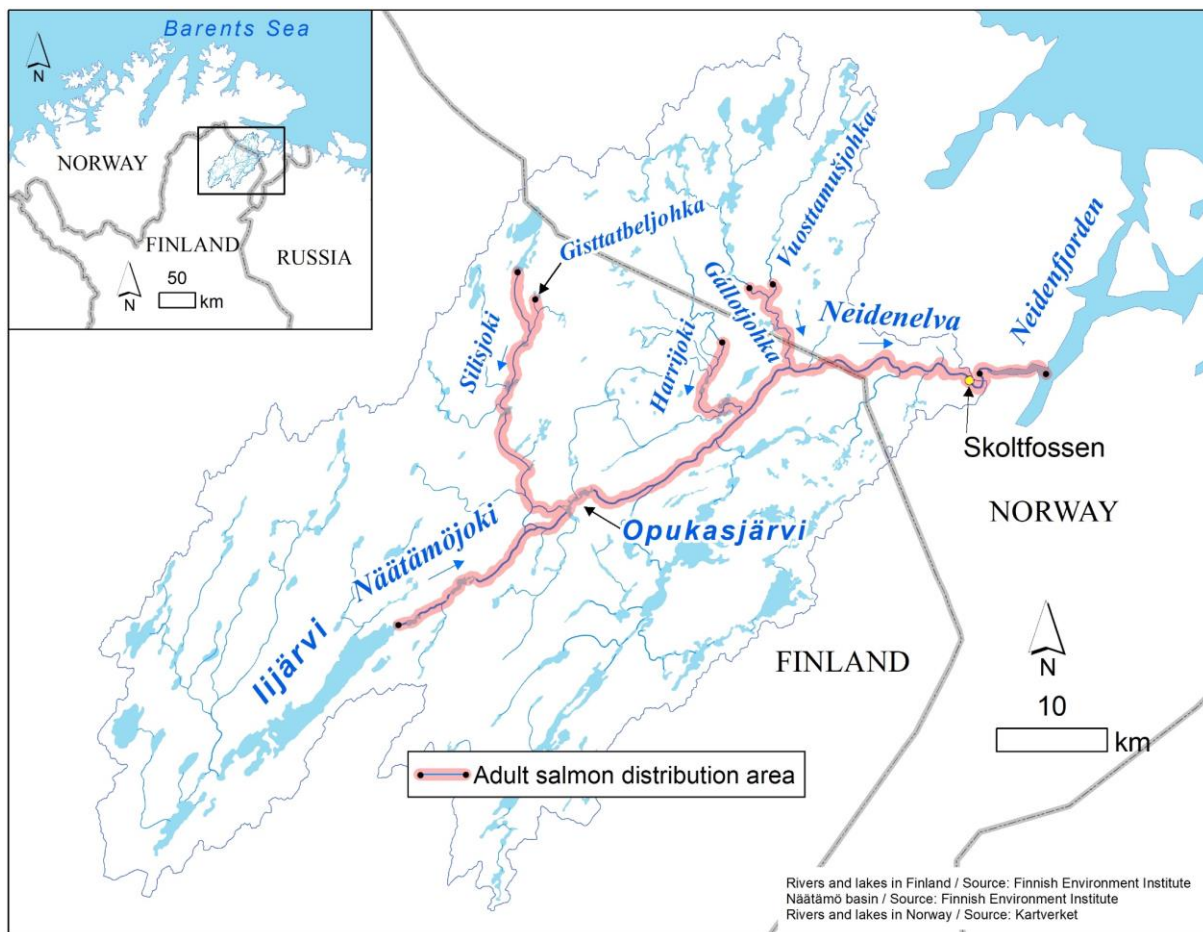
## 2. Study area and methods

### 2.1. The River Kallojoki

The River Kallojoki is a medium sized tributary of the River Näätamöjoki (catchment area 2962 km<sup>2</sup>) and it flows from north to the Näätamöjoki main stem c. 32 km upstream from the river mouth (**Figure 1**). The catchment area of Kallojoki is c. 400 km<sup>2</sup> and is mostly located on the Norwegian side of the watershed.

In 1950s two of the upper headwater lakes (Kjerringvatn and Garsjøen) and their catchment area were diverted to the Duttajohka watershed to increase hydropower production at the Gandvik powerplant (**Figure 2**). This reduced the Kallojoki catchment area by 64 km<sup>2</sup> (16%) and based on simulated calculations decreased the mean annual river flow c. 1m<sup>3</sup>/s. The effect of diminished catchment (c. 30%) and decreased flow has been especially large in the upper Kallojoki river above the confluence of the tributary river Vuosttamusjohka.

The Kallojoki is characterised by rather steep and stony rapids (**Figure 3**) and slowly flowing pool sections with sand-mud substrate (**Figure 4**). Rather limited amount of river sections with suitable gravel habitat for salmon spawning is available. The most significant spawning area is located in the upper reaches of the Kallojoki main stem just below an impassable waterfall (**Figure 5**).



**Figure 1.** The River Näätamöjoki watershed and estimated regular adult salmon distribution area based on current knowledge.





**Figure 3.** Typical steep bedrock-stone dominated rapid section of the River Kallojoki.  
Photo: Panu Orell.



**Figure 4.** Large slowly flowing pools separate the rapid sections in the River Kallojoki.  
Photo: Panu Orell.



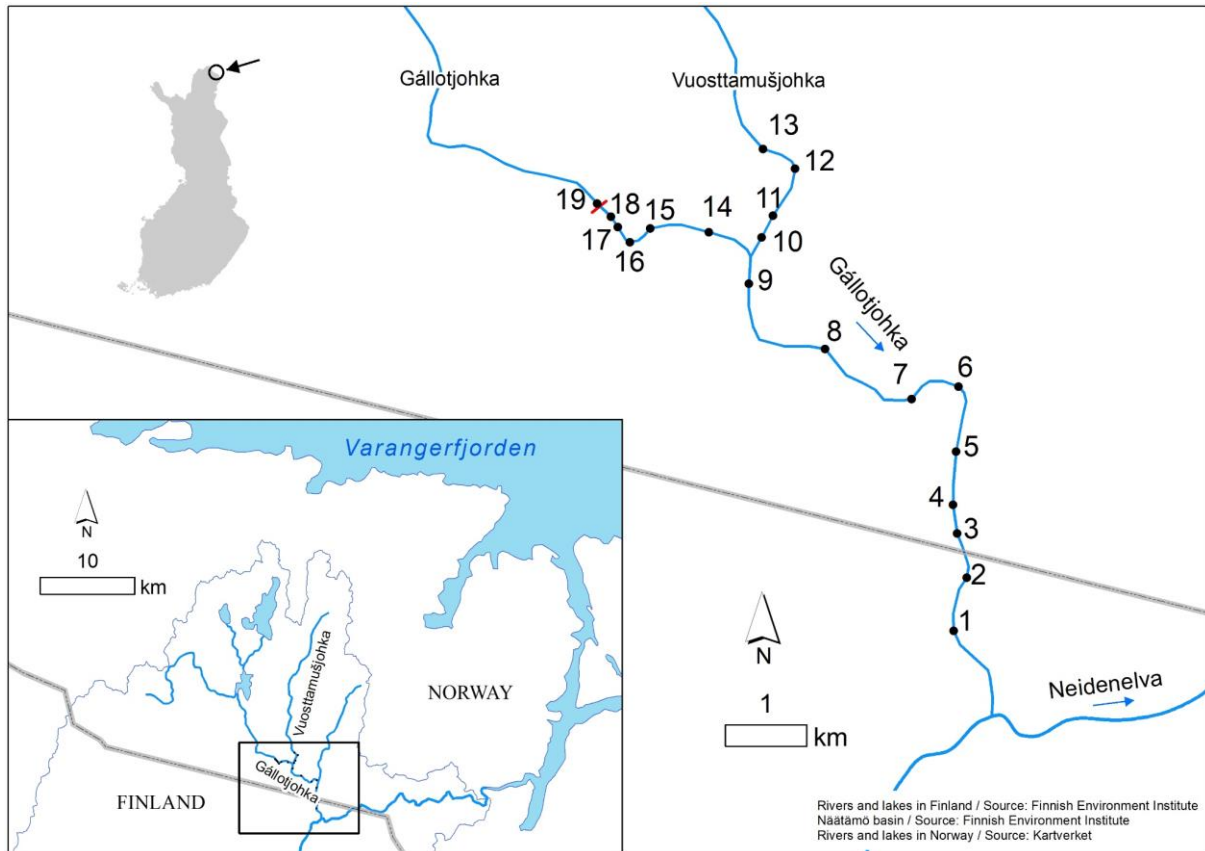
**Figure 5.** The best salmon spawning areas was found from the upper reaches of the Kallojoki main stem below an impassable waterfall. Photo taken from the electrofishing site 16. Photo: Panu Orell.

## 2.2. Electrofishing survey

Electrofishing survey in Kallojoki was conducted in 13.–16.8.2024 by Natural Resources Institute Finland (Luke). The electrofishing team consisted of two persons, one using the anode and one dip netting the stunned fish. All electrofishing was performed with generator powered equipment (Hans Grassl, model ELT60 II GI).

In total 19 sites were electrofished in Kallojoki, 15 in the Kallojoki main stem and 4 in the tributary river Vuosttamušjohka (**Figure 6**). Sites were chosen to represent different habitat types (flow, depth, bottom substrate size) available in the Kallojoki system. Each site was sampled by electrofishing 5–7 minutes/site starting from shore, heading to middle river and back to shore, and repeating this procedure to upstream direction.

Caught salmon juveniles were divided to three age-groups based on their lengths and in unsure cases based on age determination from scale samples. The age-groups were fry (0+), one-year old parr (1+) and older than one-year old parr (>1+). The electrofishing results are shown in numbers per 100m<sup>2</sup>, based on the assumption that a 6 m<sup>2</sup> area was covered per one minute of electrofishing. All the density estimates are uncorrected single-pass results.



**Figure 6.** Electrofishing sites of the river Kalliojoki and its tributary Vuosttamušjohka. The red line between the sites 18 and 19 indicates the location of a waterfall believed to be a migration obstacle for salmon (see **Figure 7**).

### 2.3. Spawning target

The first-generation spawning targets of the Näätamöjoki river, excluding the Kalliojoki system, were set in 2022 based on the methods developed in Norway (Orell et al. 2022). These methods are fully explained by Hindar et al. (2007). The same methodology was used to set the salmon spawning target for the Kalliojoki system.

Generally, the spawning target of Kalliojoki system is based on:

1. Total salmon producing wetted river area
2. Assignment of river stretches to different egg-density categories

The wetted salmon producing river area ( $m^2$ ) was calculated from digital geographic maps from Finland and Norway by using QGIS-software. Estimation of the upper limits of the salmon production area was based on the electrofishing survey conducted in 2024. In the main stem of the Kalliojoki river electrofishing data indicated the real upper limit of the salmon distribution area, but in the Vuosttamušjohka salmon distribution was estimated to continue significantly upstream from the uppermost electrofishing site (see Figure 6). Based on map and aerial photos, the potential uppermost salmon limit in Vuosttamušjohka was estimated to be located below a high waterfall (coordinates 575086/7749471; UTM 35; Figure 2).

Four egg-density categories corresponding to the stock-recruitment (S/R) variation observed in nine Norwegian index rivers were established (Hindar et al. 2007). The four egg-density categories were defined as follows (see Falkegård et al. 2014):

- 1 egg/m<sup>2</sup> (lower and upper limits: 0.5-1.5 eggs/m<sup>2</sup>). These are unproductive rivers with a low catch of salmon per area unit. A large proportion of the area has a poor habitat quality for juvenile production and/or spawning.
- 2 eggs/m<sup>2</sup> (lower and upper limits: 1.5-3 eggs/m<sup>2</sup>). These are medium productive rivers with a varied habitat quality for juvenile production and spawning.
- 4 eggs/m<sup>2</sup> (lower and upper limits: 3-5 eggs/m<sup>2</sup>). A large proportion of the area in these rivers is good habitat for juvenile production and spawning. The catch per unit river area is relatively high.
- 6 eggs/m<sup>2</sup> (>5 eggs/m<sup>2</sup>). These are highly productive rivers with very good habitat quality.

In addition to the four egg-density categories, a category of 0 egg/m<sup>2</sup> was used in river areas and lakes that were estimated to be of no or very limited value to salmon production.

The assignment of a certain river stretch to a particular egg-density category is a subjective process relying heavily on local knowledge about river characteristics (extent and quality of spawning and juvenile production areas) and river history (e.g. catch data). This local knowledge was mostly based on Luke's personnel (Panu Orell and Mikko Kytökorpi) conducting the Kallojoki electrofishing survey in 2024.

The spawning target estimated by the above approach is the total number of spawned eggs needed to fulfil the production potential of the Kallojoki system. For management-practical reasons this egg deposition level was converted to female salmon biomass needed at spawning to produce the target number of eggs. As the fecundity of Näätamöjoki salmon is not fully known we used two different fecundity options in this report. The first option was based on Hindar et al. (2007) with a fixed relative fecundity of 1800 eggs/female salmon kg. The second option (2225 eggs/female salmon kg) was derived from the Teno/Tana system by using the relative fecundity of the River Inarijoki/Anarjohka system with a rather similar salmon sea-age structure as the Näätamöjoki/Neidenelva system.

The mean weight of female spawner used in calculations (4.65 kg) was obtained from Näätamöjoki catch sample collections from 2011-2020 (cf. Kytökorpi et al. 2024). Although the spawning targets are expressed in female salmon biomass and numbers, male salmon are also needed for successful spawning and recruitment. This should be noted in interpreting the results of this report.

### 3. Results

#### 3.1. Electrofishing and salmon distribution

Salmon juveniles were caught from all the electrofishing sites except the site 19, which was located above a c. 4 m high waterfall (**Table 1, Figure 6, Figure 7**). Highest densities of juveniles of all age-groups were found from the c. 1 km long river stretch just below the Kallojoki waterfall (sites 16-18, **Table 1**). In the tributary river Vuosttamušjohka salmon juveniles, including fry (0+) were found from the uppermost electrofishing site (13, **Table 1**), and potential salmon habitats clearly continued from that site upstream.

The estimated age-specific mean densities in Kallojoki were roughly at the same level that is observed in the middle reaches of the Näätamöjoki main stem between Lake Opukasjärvi and the border.

Other species caught by electrofishing were minnow (*Phoxinus phoxinus*) and pike (*Esox lucius*). Some larger pikes were also seen when walking on the shores. No adult salmon were observed during the survey days.

**Table 1.** Coordinates of the Kallojoki electrofishing sites and estimated site-specific salmon juvenile densities divided to three age-categories. Mean age-specific densities are also shown. The salmon numbers are uncorrected single-pass electrofishing densities.

River	Site nr.	X	Y	Estimated salmon density/100m <sup>2</sup>			
				0+	1+	≥1+	all
Kallojoki	1	575368	7735888	0,00	0,00	2,78	2,78
Kallojoki	2	575653	7736491	6,67	0,00	6,67	13,33
Kallojoki	3	575642	7737046	3,33	3,33	6,67	13,33
Kallojoki	4	575662	7737397	16,67	30,00	6,67	53,33
Kallojoki	5	575823	7738028	3,33	6,67	3,33	13,33
Kallojoki	6	576008	7738801	20,00	0,00	0,00	20,00
Kallojoki	7	575418	7738764	30,00	13,33	10,00	53,33
Kallojoki	8	574499	7739570	10,00	23,33	6,67	40,00
Kallojoki	9	573741	7740532	0,00	0,00	10,00	10,00
Vuosttamušjohka	10	574004	7741057	0,00	0,00	2,38	2,38
Vuosttamušjohka	11	574191	7741292	20,00	3,33	20,00	43,33
Vuosttamušjohka	12	574570	7741801	0,00	0,00	13,33	13,33
Vuosttamušjohka	13	574231	7742112	30,00	0,00	10,00	40,00
Kallojoki	14	573386	7741245	20,00	3,33	6,67	30,00
Kallojoki	15	572690	7741432	5,56	5,56	0,00	11,11
Kallojoki	16	572415	7741314	97,22	25,00	5,56	127,78
Kallojoki	17	572304	7741526	50,00	16,67	3,33	70,00
Kallojoki	18	572246	7741667	30,00	83,33	13,33	126,67
Kallojoki	19	572112	7741855	0,00	0,00	0,00	0,00
			Mean	18,04	11,26	6,70	36,00

Based on the electrofishing results the upper limit (waterfall, coordinates UTM 35: 572123/ 7741808) of the salmon distribution area in the Kallojoki main stem was found (**Figure 2, Figure 7**). The waterfall looked very difficult for adult salmon to pass, but theoretically it could be possible under certain flow conditions.

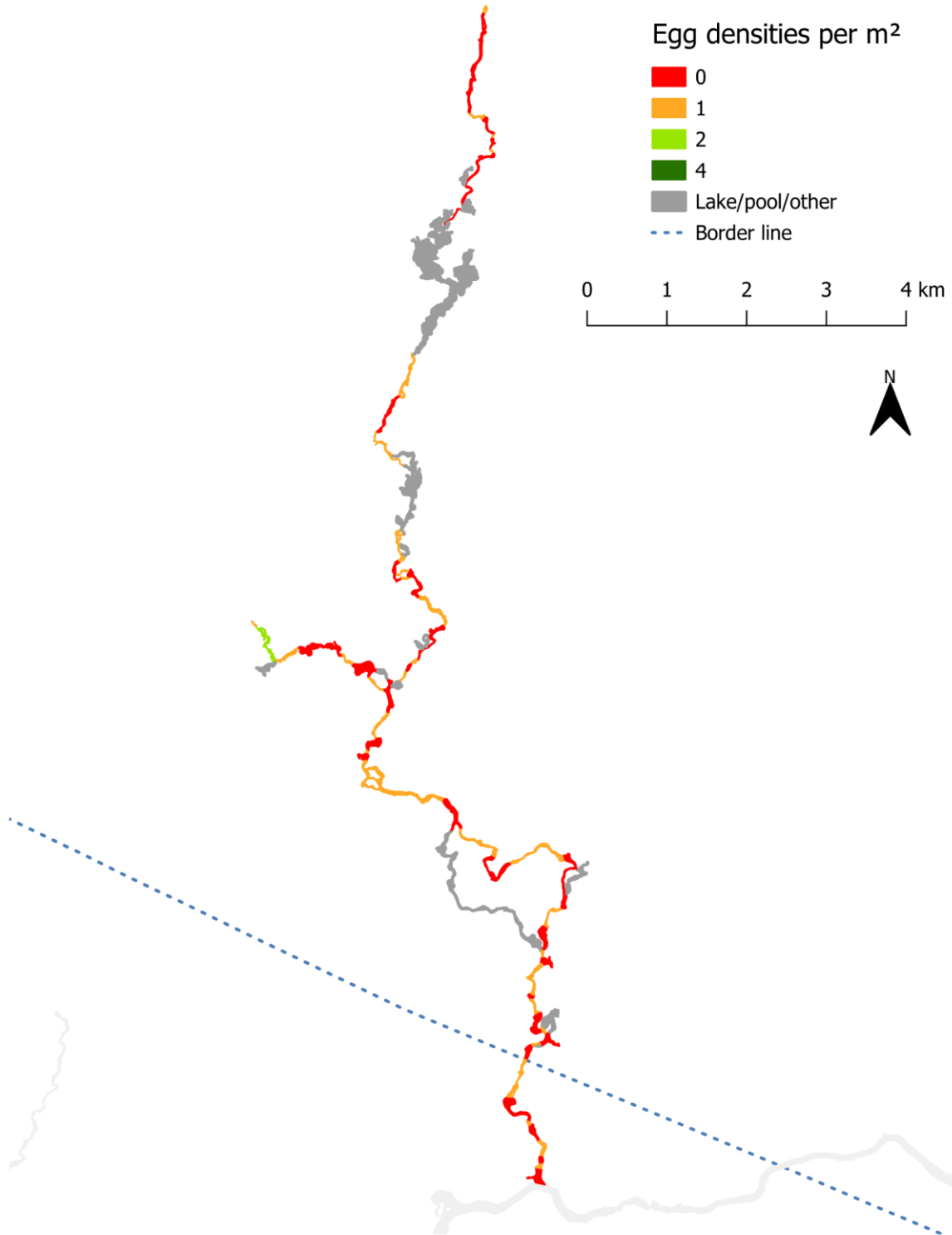
In the river Vuosttamušjohka salmon distribution area clearly continues upstream from the uppermost electrofishing site. Based on the map and aerial photos, salmon distribution area could continue to the large waterfall located at coordinates 575086/7749471 (UTM 35), c. 11 km upstream from the Vuosttamušjohka river mouth (see Figure 2).



**Figure 7.** An impassable waterfall (height c. 4 m) for salmon located in the Kallojoki main stem c. 13 km upstream from the river mouth. Salmon densities were rather high below the waterfall and no individuals were found above the waterfall (electrofishing site 19). Photo: Panu Orell.

### 3.2. Spawning target for the Kallojoki river

Salmon production area of the Kallojoki main stem starts below an impassable waterfall (UTM35: 572123/ 7741808). The best salmon spawning and juvenile production area (2 eggs/m<sup>2</sup>) was located shortly below the waterfall (**Figure 8**). Rest of the Kallojoki main stem production areas were classified either as non-productive (0 eggs/m<sup>2</sup>) or low-productive (1 egg/m<sup>2</sup>; **Figure 8**). The non-productive areas were mostly slowly flowing pools with sand-mud substrate. Overall, the main limiting factors for salmon production in the Kallojoki main stem are the small amount of spawning grounds and limited supply of nursery areas for 0+ juvenile salmon.



**Figure 8.** Map of the River Kallajoki (including Vuosttamušjohka) system including the river areas with different egg density (eggs/m<sup>2</sup>) classes set. Lakes and dry river channels (grey colour) were not included in the spawning targets.

The estimated spawning target of the Kallojoki main stem is c. 245 000 eggs. In female biomass (kg) this becomes 136 kg when using a fecundity of 1 800 eggs/female salmon kg (from Hindar et al. 2007) or 110 kg when using a fecundity of 2225 eggs/female salmon kg (fecundity data from the Teno-Inarijoki salmon). In numbers of female salmon (mean weight 4.65 kg) these biomasses convert to 30 and 24 individuals, respectively (**Table 2**).

**Table 2.** Summary table of the Kallojoki main stem production area (m<sup>2</sup>) and spawning target calculations. Two different fecundity options (1800 vs. 2225 eggs/female salmon kg) were used in the calculations (see Methods). Mean female salmon weight of 4.65 kg was used in converting the female salmon biomass (kg) to numbers of female salmon.

Area with 0 eggs/m <sup>2</sup>	334 767
Area with 1 eggs/m <sup>2</sup>	210 511
Area with 2 eggs/m <sup>2</sup>	17 394
Area with 4 eggs/m <sup>2</sup>	0
<b>Spawning target (number of eggs)</b>	
Lower limit (eggs)	131 346
Upper limit (eggs)	367 947
<b>Spawning target (female biomass kg, 1800)</b>	
Lower limit (kg)	73
Upper limit (kg)	204
<b>Spawning target (number of female salmon)</b>	
<b>30</b>	
<b>Spawning target (female biomass kg, 2225)</b>	
Lower limit (kg)	59
Upper limit (kg)	165
<b>Spawning target (number of female salmon)</b>	
<b>24</b>	

Salmon production area of the River Vuosttamušjohka was estimated to start below an impassable waterfall (UTM35: 575086/7749471), although this is not confirmed by a field survey and electrofishing. Like the main stem of the River Kallojoki also Vuosttamušjohka is characterized by rather steep rapids and large stone/bedrock dominated substrate and slow-flowing sand-mud dominated pools and lakes. The river habitats were classified either as non-productive (0 eggs/m<sup>2</sup>) or low-productive (1 egg/m<sup>2</sup>)(**Figure 8**). Very limited supply of spawning grounds and 0+ juvenile nursery areas were the main limiting factors also in Vuosttamušjohka.

The estimated spawning target of the Vuosttamušjohka is c. 78 500 eggs. In female biomass (kg) this becomes 44 kg when using a fecundity of 1 800 eggs/female salmon kg or 35 kg when using fecundity of 2225 eggs/female salmon kg. In numbers of female salmon (mean weight 4.65 kg) these biomasses convert to 10 and 8 individuals, respectively (**Table 3**)

**Table 3.** Summary table of the River Vuosttamušjohka production area (m<sup>2</sup>) and spawning target calculations. Production area included the known and estimated salmon distribution area (see **Figure 2**). Two different fecundity options (1800 vs. 2225 eggs/female salmon kg) were used in the calculations (see Methods). Mean female salmon weight of 4.65 kg was used in converting the female salmon biomass (kg) to numbers of female salmon.

Area with 0 eggs/m <sup>2</sup>	554 762
Area with 1 eggs/m <sup>2</sup>	78 531
Area with 2 eggs/m <sup>2</sup>	0
Area with 4 eggs/m <sup>2</sup>	0
<b>Spawning target (number of eggs)</b>	
Lower limit (eggs)	39 266
Upper limit (eggs)	117 797
<b>Spawning target (female biomass kg, 1800)</b>	
Lower limit (kg)	22
Upper limit (kg)	65
<b>Spawning target (number of female salmon)</b>	
<b>10</b>	
<b>Spawning target (female biomass kg, 2225)</b>	
Lower limit (kg)	18
Upper limit (kg)	53
<b>Spawning target (number of female salmon)</b>	
<b>8</b>	

The total Kallojoki spawning target is c. 324 000 eggs. In female biomass (kg) this becomes 180 kg when using a fecundity of 1 800 eggs/female salmon kg or 146 kg when using fecundity of 2225 eggs/female salmon kg. In numbers of female salmon (mean weight 4.65 kg) these biomasses convert to 39 and 32 individuals, respectively (**Table 4**).

The proportion of Kallojoki spawning target located on the Finnish side is c. 9,6% (31 161 eggs).

**Table 4.** Summary table of the Kallojoki total production area (m<sup>2</sup>) and spawning target calculations. Two different fecundity options (1800 vs. 2225 eggs/female salmon kg) were used in the calculations (see Methods). Mean female salmon weight of 4.65 kg was used in converting the female salmon biomass (kg) to numbers of female salmon.

Area with 0 eggs/m <sup>2</sup>	889 529
Area with 1 eggs/m <sup>2</sup>	289 042
Area with 2 eggs/m <sup>2</sup>	17 394
Area with 4 eggs/m <sup>2</sup>	0
<b>Spawning target (number of eggs)</b>	
Lower limit (eggs)	170 611
Upper limit (eggs)	485 744
<b>Spawning target (female biomass kg, 1800)</b>	
Lower limit (kg)	95
Upper limit (kg)	270
<b>Spawning target (number of female salmon)</b>	<b>39</b>
<b>Spawning target (female biomass kg, 2225)</b>	
Lower limit (kg)	77
Upper limit (kg)	218
<b>Spawning target (number of female salmon)</b>	<b>32</b>

### 3.3. Updated Näätmöjoki/Neidenelva total spawning target

After adding the Kallojoki spawning targets, the total spawning target of the whole Näätmöjoki/Neidenelva system is c. 10 500 000 salmon eggs (Table 5). This converts to 5814 kg of female salmon when using the fecundity of 1800 eggs/female salmon kg and 4703 kg when using the fecundity level of 2225 eggs/female salmon kg (Table 5). Based on the production area size and their value to salmon production 66% of the spawning target (in eggs) is situated in Finland and 34% in Norway. In practice, depending on the chosen fecundity level, c. 650-800 spawning female salmon averaging a weight of 4.65 kg are annually needed on the Finnish side and c. 360-450 females on the Norwegian side to fulfil the spawning targets.

**Table 5.** Summary table of the Näätamöjoki/Neidenelva total production area (m<sup>2</sup>) and spawning target calculations after adding Kallojoki data. Two different fecundity options (1800 vs. 2225 eggs/female salmon kg) were used in the calculations (see Methods). Mean female salmon weight of 4.65 kg was used in converting the female salmon biomass (kg) to numbers of female salmon.

Area with 0 eggs/m <sup>2</sup>	2 556 851
Area with 1 eggs/m <sup>2</sup>	1 528 521
Area with 2 eggs/m <sup>2</sup>	3 443 304
Area with 4 eggs/m <sup>2</sup>	512 381
<b>Spawning target (number of eggs)</b>	
Lower limit (eggs)	7 466 359
Upper limit (eggs)	15 184 598
<b>Spawning target (female biomass kg, 1800)</b>	
Lower limit (kg)	4 148
Upper limit (kg)	8 436
<b>Spawning target (number of female salmon)</b>	
<b>1 250</b>	
<b>Spawning target (female biomass kg, 2225)</b>	
Lower limit (kg)	3 356
Upper limit (kg)	6 825
<b>Spawning target (number of female salmon)</b>	
<b>1 011</b>	

## 4. Discussion

The River Kallojoki was the last significant tributary of the Näätamöjoki without updated information on its salmon production. The electrofishing survey conducted in 2024 proved that considerable juvenile production still occurs in Kallojoki and in its tributary Vuosttamušjohka despite the decreased discharge caused by the water direction to the Gandvik power plant. The spawning population size of Kallojoki system is not known and there is very limited information on salmon catches from the system. Even though juvenile densities were at a reasonable level, the actual spawning stock size may be rather low, especially when considering the recent decline of the Näätamöjoki salmon population (Kytökorpi et al. 2024). Declining salmon stocks together with the weakened environmental conditions, i.e. the reduced flow in the Kallojoki suggest that caution needs to be used when planning fishing in the Kallojoki system. Currently the best option would be that no salmon fishing is allowed in the Kallojoki.

The electrofishing trip also revealed the upper limit of the salmon production area in the Kallojoki mainstem. In the tributary river Vuosttamušjohka, however, the upper limit was not found, and potential juvenile production area may continue significantly upstream from the uppermost electrofishing site. A potential upper limit was, however, found based on map and aerial photo inspections.

The spawning target of the Kallojoki system was estimated to be rather small (180 kg of females). This is partly caused by the fact that part of the Kallojoki production area has been lost due to the lowered discharge. Secondly, very limited spawning habitats and nursery areas for 0+ salmon juveniles are available in the system.

The overall Näätamöjoki spawning target defined in 2022 (Orell et al. 2022) increased slightly after including the Kallojoki system: the current spawning target of the whole system is 5814 kg of female salmon (5634 kg without the Kallojoki; Orell et al. 2022). The inclusion of the Kallojoki system did not affect the overall spawning target share between Finland and Norway.

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## References

- Falkegård, M., Foldvik, A., Fiske, P., Erkinaro, J., Orell, P., Niemelä, E., Kuusela, J., Finstad, A.G. & Hindar, K. 2014. Revised first-generation spawning targets for the Tana/Teno river system. NINA report 1087. 68 s.
- Forseth, T., Fiske, P., Barlaup, B., Gjøsæter, H., Hindar, K. & Diserud, O.H. 2013. Reference point based management of Norwegian Atlantic salmon populations. *Environmental Conservation* 40(4): 356–366.
- Hindar, K., Diserud, O., Fiske, P., Forseth, T., Jensen, A.J., Ugedal, O., Jonsson, N., Storeid, S.E., Arnekleiv, J.V., Saltveit, S.J., Sægrov, H. & Sættem, L.M. 2007. Gytebestandsmål for laksebestander i Norge. [Spawning targets for Atlantic salmon populations in Norway] NINA Report 226. 78 p. (in Norwegian with English summary).
- Kytökorpi, M., Tynkkynen, R., Kylmäaho, M., Kuusela, J., Haantie, J., Erkinaro, J. & Orell, P. 2024. Näätämöjoen lohikannan tila: Nousulohimäärät, lohisaaliit ja poikastiheydet [Status of the Atlantic salmon stocks in the River Näätämöjoki: Salmon runs, catches and juvenile densities]. *Luonnonvara- ja biotalouden tutkimus 81/2024*. Luonnonvarakeskus. Helsinki. 56 s. [Natural resources and bioeconomy studies 81/2024. Natural Resources Institute Finland. Helsinki. 56 p.]. In Finnish with an English abstract.
- Niemelä, E., Länsman, M., Hassinen, E., Kuusela, J., Haantie, J., Kylmäaho, M., Kivilahti E., Arvola K.-M. & Kalske, T.H. 2018b. Flerbruksplan for Neidenvassdraget del I: Miljøforhold i Neidenvassdraget: neidenlaksens økologi, vandring og fangsttidspunkter i sjøen og i elva, samt særtrekk i laksefisket i Varangerfjorden. *Fylkesmannen i Finnmark rapport 3-2018*. 276 p. (in Norwegian; same report in Finnish: Niemelä et al. 2018b. Näätämöjoen ympäristöolosuhteet, lohen ekologia, Näätämön lohen vaellus ja saaliin ajoittuminen meressä ja joessa sekä Varanginvuonon lohenkalastuksen erityispiirteitä. Näätämöjoen moninaiskäyttösuunnitelma, osa I.).
- Orell, P., Kuusela, J., Kylmäaho, M., Foldvik, A., Hindar, K. & Erkinaro, J. 2022. Spawning targets for Atlantic salmon in the River Näätämöjoki/Neidenelva. *Natural resources and bioeconomy studies 98/2022*. Natural Resources Institute Finland. Helsinki. 24 s.



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