

**European river lamprey**  
***Lampetra fluviatilis***  
**larvae monitoring –**  
**method description**  
**and protocol**

**2025**

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## 1. General description.

European river lamprey *Lampetra fluviatilis* larvae monitoring has been carried out in Latvia since the nineties of the 20th century, however, noticeable attempts to improve the monitoring methodology were started only in second decade of 21<sup>st</sup> century. So far, the best and based on mathematical calculations methodology was developed in project “Cross-boundary evaluation and management of Lamprey stocks in Lithuania and Latvia (LLI-310 LAMPREY)” that was realized from 2018 until 2020. This particular methodology has been applied to the monitoring of lamprey larvae since 2022 and so far has been proven to be efficient. Throughout the recent field works, however, it has become apparent that quite a few improvements must be made in order to increase the overall effectiveness of the use of the methodology, while at the same time maintaining the intended usefulness in monitoring the success of lamprey natural reproduction and in evaluating the dictating factors of the distribution of lamprey larvae.

The second edition of the methodology, where the main principles of the monitoring of lamprey larvae have been preserved and additional changes in the form and the information collection have been applied can be found below.

Monitoring of lamprey larval density should be carried out by bottom sampling using a stainless steel box (dimensions 30 x 40 x 55 cm) as described by Lasne et al.<sup>1</sup> 2010. At each sampling site, 12 samples should be taken with the box and the total length of all captured lamprey larvae should be measured to the nearest mm. Considering the variation in length of the captured larvae, they should be divided into three age groups - 0+, 1+ and >1+. At least 80 sampling sites should be sampled annually. The expected outcome of the lamprey larval density monitoring is information on the number of lamprey larvae of each age group in each of the 80 sampling sites (ANNEX IV).

## 2. Process of sampling:

### 2.1. Description of sampling site.

Overall information of the sampling site must be recorded in the form – number of the sampling site, date of sampling, name of the river, the respective river catchment, geographic coordinates and description of location (e.g. downstream bridge of the road V387).

Below the general information the overall description of the sampling site (part of the river where actual sampling will be performed) and the adjacent part of the river (as far as it can be seen from the sampling site) is recorded.

**Depth zones** (<35; 35-45; >45 cm) in the sampling site and the adjacent part of the river that must be evaluated using the Braun-Blanquet scaling. The scales are: “+”, which means less than 1% of the particular depth zone is present at the site; “1” with 1 – 5 % present at the site; “2” with 5 – 25% present; “3” with 25 – 50% present; “4” with 50 – 75% present and “5” with 75 – 100% present at the site. All of these depth zones coverages cannot overlay (sum=5). Proportion of depth zones is evaluated approximately by expert judgement.

**The average width** of the stream is measured accurately if possible or estimated approximately if accurate measurement is not possible.

**The coverage of macrophytes** (algae, nympheids, elodeids, helophytes and lemids) is estimated using the Braun-Blanquet scaling without overlaying (sum=5). Information on respective groups of macrophytes are specified below the table.

**Stream velocity** category and presence of tributary in the sampling spot or just upstream of it. Categories of stream velocity are as follows: “0” - no visible water movement in the sampling plot or within sight; “1” – water flows in the sampling plot or within sight, but does not exceed 0.2 m/s; “2” – within sight there is a section, where stream velocity exceeds 0.2 m/s; “3” – the stream velocity exceeds 0.2 m/s before and after sampling plot, but within sight there are also slower sections; “4” – the stream velocity exceeds 0.2 m/s everywhere or almost everywhere. Width of tributaries should be registered in the form and if there are no tributaries, the respective box should be marked with “\_”.

**Three types of anthropogenic impact** must be registered: recreational and other activities (wading, boating or swimming), digging of a stream channel (e.g. for melioration or other purposes), or an object (e.g. bridge, embankment). The proportion of the sampling site and the adjacent part of the river affected by the particular type of

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<sup>1</sup> Lasne, E., Sabatié, M. R., Tremblay, J., Beaulaton, L., & Roussel, J. M. (2010). A new sampling technique for larval lamprey population assessment in small river catchments. *Fisheries Research*, 106(1), 22-26.

impact must be indicated using the Braun-Blanquet scaling without overlaying (sum=5). The proportion is determined using expert judgement. The distance to the dam or other migration obstacles must also be recorded. After sampling, available databases must be searched to ensure that there are no dams or hydroelectric power stations located outside visibility range from sampling site.

**The dominating substratum** in the stream should be estimated. It might be unsuitable for lampreys (e.g. clay, dolomite or limestone), stony (share of stones should exceed 50% and average diameter of stones must be at least 20 cm), mixed (stone from 30 to 50%, sand and gravel), sand and gravel (share of gravel at least 5%), or soft (dominated by sand and/or detritus, share of gravel <5% and stones <30%). Only one category can dominate, therefore only one is marked in the protocol. If the sampling plot is the same size as the river section, it is not necessary to mark both boxes.

**The current water** levels of the river are evaluated with marking one of the five options corresponding to the sampling site in the table below (extremely low (dry or almost dry river bed) moderately low (some aquatic plants are no more in the water), normal, moderately high (some amphibian plants are covered in water) or extremely high (at least 0.5 m higher than normal water level in summer)). In each site, a photography of river section is taken, and the time of this action recorded in the form.

The first page of the form is advised to be completed right after arriving to the sampling site (ANNEX I).

## 2.2. Sampling and description of samples.

A total of 12 bottom samples should be taken per a sampling site. Each sample is already numbered, but all other sections must be marked during the sampling (ANNEX II). As mentioned previously, location of samples must be proportional to riverbed heterogeneity groups and to depth zones within each of these groups within the sampling site. Location of each sample should be considered before the beginning of sampling, and sampling should be started with the closest sample. NB! Do not sample in places you have previously disturbed by wading, standing, washing of samples or in any other way.

Sampling procedure itself is described by Lasne *et al.* 2010. In general, sampling procedure consists of pushing the sampling box into the riverbed and digging sediment into a net bag attached to one side of a box (Figure 1). Then substrate is washed through the same net and larvae remained in net collected.

Samples should be taken in straight lines (transects) from the middle of the river to the bank. The preferred number of transects is three, with four samples taken in each transect. If it is not possible to take the appropriate number of transects or samples due to excessive depth or other circumstances of the sampling site, modifications are allowed (three samples in four transects, two samples in six transects, etc.).

For each sample the average depth is measured and recorded as well as the stream velocity (m/s) (marking the appropriate stream velocity group (1 = 0-0,05 m/s, 2 = >0,05-0,1 m/s, 3 = >0,1-0,2 m/s, 4 = >0,2-0,4 m/s, 5 = >0,4 m/s)), the number of transect where the sample is collected as well as the sample number and the distance from the bank. In addition, the category of slope of the riverbed ("0" – horizontal or slightly sloping, "1" – sloping, "2" – sloping a lot, "3" – vertical or almost vertical slope) is recorded as well as the coverage of different groups of macrophytes using the Braun-Blanquet scaling (sum=5).

If the sample location overlays with some anthropogenic activity/impact (e.g. sample is located exactly where boats have been dragged out of the water) it must be marked in the table.

Approximate share of different type of substrate (organic, sand, gravel and stone) should also be evaluated. After taking the bottom sample, the sampling person approximately estimates the amount of substratum in the sampling net before and after washing and evaluates, the proportion of sand that has been washed from the sample. Then approximate proportion of organic substrate, sand, gravel and stone remained in the net should be estimated. In the table sampling person writes organic matter using the Braun-Blanquet scaling (sum cannot overlay (sum=5)).



**Figure 1.** The process of collecting bottom samples.

### **2.3. Handling of larvae.**

Captured lamprey larvae should be counted and measured with sedation (a solution of clove oil was used successfully, 2-3 drops/100 ml) and measured measurements should be done with accuracy 0,1 cm (Figure 2). It is advised to release the larvae that are visibly a part of the 0+ age group (i.e., length <20 mm) (evaluated approximately by expert judgement) without measuring (meaning only the amount of larvae (n) should be put down in the protocol). After measuring, larvae should be released back in the river as soon as possible. NB! If larvae are released while sampling is still being continued, must be released in at least 10 m (preferably – more) distance downstream of the actual sampling site. Length data are recorded in the table of ammocoetes, which is the third section of the form (ANNEX III). First column of this section contains the sample number in which each larva has been found. The second column is for larva number (N<sup>o</sup>) of each sample. The length of larva (mm) is registered in the third column, and the last column is left for notes (e.g. the larva has started metamorphosis or other).



**Figure 2.** The process of measuring European river lamprey larvae.

## ANNEX I

### 1. Overview of the River Section

N<sup>o</sup> \_\_\_\_\_ DATE \_\_\_\_\_ RIVER \_\_\_\_\_ CATCHMENT \_\_\_\_\_

PLACE \_\_\_\_\_ COORDINATES \_\_\_\_\_ / \_\_\_\_\_

	Depth < 35 cm	Depth 35-45 cm	Depth > 45 cm	Width, m	Macrophyte coverage*, sum=5
River					
Sampling site					

**Macrophyte coverage\*, sum=5:** algae \_\_\_\_\_, nympheids \_\_\_\_\_, elodeids \_\_\_\_\_, helophytes \_\_\_\_\_, lemnids \_\_\_\_\_

**In the sampling plot\*, sum=5:** algae \_\_\_\_\_, nympheids \_\_\_\_\_, elodeids \_\_\_\_\_, helophytes \_\_\_\_\_, lemnids \_\_\_\_\_

(Section "in the sampling plot" must be filled only if the sampling plot isn't all across the river)

**Nympheids** – leaves and blossoms on the water surface (*Nymphaoides, Nuphar, Sagittaria, Sparganium, Potamogeton*); **Elodeids** – fully underwater except for the blossoms (*Elodea, Myriophyllum, Potamogeton*) **Helophytes** – only the bottom of plants body is under water (*Phragmites, Typha, Sparganium*); **Lemnids** – floating on water surface (*Lemna, Hydrocharis*) **Note: the category of waterplants sometimes depends on the emplacement of leaves in the water, e.g. Sparganium or Potamogeton**

**Stream velocity category:** \_\_\_\_\_

**0** – there is no visible water movement nor in sampling plot, nor within sight; **1** – if in the sampling plot or within sight water flows, but does not exceed 0,2 m/s; **2** – if within sight there is a section, where stream velocity exceeds 0,2 m/s; **3** – if stream velocity exceeds 0,2 m/s **before and after** sampling plot, but within sight are also slower sections; **4** – if stream exceeds 0,2 m/s everywhere or almost everywhere.

**Tributary** (in the sampling site or upstream of it, if there is one), width m \_\_\_\_\_

**Anthropogenic impact\*, sum=5**

	Activity		Digging		Object		Migration obstacles		Beaver dam	
	Recent	Long ago	Recent	Long ago	Recent	Long ago	Distance to dam, m	Distance to HPP, m	Above, dist, m	Below dist, m
River										
Sampling plot										

**Activity** – place disturbed by wading, boating, swimming etc. (recently – if the marks of boats, people, cars are visible; long ago if there are no visible marks of recent activity); **Digging** – digging, melioration or other significant mechanical change of riverbed (recently, if the biotopes are determined by modifications; long ago, if the riverbed has already +/- modified back to normal) **Object** – bridge, embankment etc. (recently, if the marks of construction activities are visible in riverbed; long ago, if only the object itself is visible); **Migration obstacles** – dam, weir, waterfall or other obstacle, that has significant impact on lamprey migration, mark if it is hydro power plant or other, or both, and the distance to it, in meters (from databases and/or maps) ; **Beaver dam** – if within sight

**DOMINATING SUBSTRATUM CATEGORY (only one of the categories, if the sampling plot is all across the river, then mark only on "river", if not then also in "sampling plot"):**

RIVER	SAMPLING PLOT
Unsuitable Clay, dolomite, etc.	Unsuitable Clay, dolomite, etc.
Stone Diameter at least 20 cm, share of stones exceed 50%	Stone Diameter at least 20 cm
Mixed, hard Stone + at least 50% sand or gravel	Mixed, hard Stone + at least 50% sand or gravel
Sand and gravel Gravel at least 5%	Sand and gravel Gravel at least 5%
Soft Detritus, sand etc. (gravel <5%, stone up to 30%)	Soft Detritus, sand etc. (gravel <5%, stone up to 30%)

**RIVERBED HETEROGENEITY IN THE SAMPLING PLOT:**

Mark proportion\*, sum=5 ONLY in that river part, where will do sampling:

**Coast-related-heterogeneity** \_\_\_\_\_

Curves, coast and pit slopes, that are related to coastline

**Riverbed-related** \_\_\_\_\_

Silts before/after/around obstacles, pit beginnings and ends

**Big formations** island/ peninsula \_\_\_\_\_

Bay in coast side of peninsula, silts after islands, mark if one of them

**In the stream** \_\_\_\_\_

+/- straight riverbed, without obvious formations

**CURRENT WATER LEVELS OF THE RIVER:**

Only one of the categories should be marked:

**Extremely low** \_\_\_\_\_

Dry or almost dry river bed

**Moderately low** \_\_\_\_\_

Some aquatic plants are no more in the water

**Normal** \_\_\_\_\_

**Moderately high** \_\_\_\_\_

Some amphibian plants are covered in water

**Extremely high** \_\_\_\_\_

At least 0.5 m higher than normal water level in summer

Time of photo: \_\_\_\_\_

ANNEX II

2. Characteristics for each sample

№	Formation		Number of digging transect	Distance from the riverside, m	Depth, cm**		Slope***		Macroph. cov*,sum=5		Stream velocity group****	Anthrop. impact	Substrate*,sum=5	
					<35	35-45	0	1	2	3			Algae	Elod
1	Coast-rel				<35	0		Algae				Yes	Organic	
	Riverb.-rel				35-45	1		Elod					Sand	
	Big form.				>45	2		Nymph				Gravel	Stone	
	Stream				3		Heloph		No					
2	Coast-rel				<35	0		Algae				Yes	Organic	
	Riverb.-rel				35-45	1		Elod					Sand	
	Big form.				>45	2		Nymph				Gravel	Stone	
	Stream				3		Heloph		No					
3	Coast-rel				<35	0		Algae				Yes	Organic	
	Riverb.-rel				35-45	1		Elod					Sand	
	Big form.				>45	2		Nymph				Gravel	Stone	
	Stream				3		Heloph		No					
4	Coast-rel				<35	0		Algae				Yes	Organic	
	Riverb.-rel				35-45	1		Elod					Sand	
	Big form.				>45	2		Nymph				Gravel	Stone	
	Stream				3		Heloph		No					
5	Coast-rel				<35	0		Algae				Yes	Organic	
	Riverb.-rel				35-45	1		Elod					Sand	
	Big form.				>45	2		Nymph				Gravel	Stone	
	Stream				3		Heloph		No					

6	Coast-rel			<35	0	Algae	Yes	Organic	
	Riverb.-rel			35-45	1	Elod		Sand	
	Big form.			>45	2	Nymph		No	Gravel
	Stream				3	Heloph			Stone
7	Coast-rel			<35	0	Algae	Yes	Organic	
	Riverb.-rel			35-45	1	Elod		Sand	
	Big form.			>45	2	Nymph	No	Gravel	
	Stream				3	Heloph		Stone	
8	Coast-rel			<35	0	Algae	Yes	Organic	
	Riverb.-rel			35-45	1	Elod		Sand	
	Big form.			>45	2	Nymph	No	Gravel	
	Stream				3	Heloph		Stone	
9	Coast-rel			<35	0	Algae	Yes	Organic	
	Riverb.-rel			35-45	1	Elod		Sand	
	Big form.			>45	2	Nymph	No	Gravel	
	Stream				3	Heloph		Stone	
10	Coast-rel			<35	0	Algae	Yes	Organic	
	Riverb.-rel			35-45	1	Elod		Sand	
	Big form.			>45	2	Nymph	No	Gravel	
	Stream				3	Heloph		Stone	
11	Coast-rel			<35	0	Algae	Yes	Organic	
	Riverb.-rel			35-45	1	Elod		Sand	
	Big form.			>45	2	Nymph	No	Gravel	
	Stream				3	Heloph		Stone	
12	Coast-rel			<35	0	Algae	Yes	Organic	



	Riverb.-rel				35-45	1		Elod					Sand	
	Big form.				>45	2		Nymph			No		Gravel	
	Stream					3		Heloph					Stone	

\*+ = <1%    **1** = 1-5%    **2** = 5 - 25%    **3** = 25-50%    **4** = 50-75%    **5** = 75-100%

\*\*precise depth must be noted

\*\*\* **0** – horizontal or a little sloping, **1** – sloping, **2** – sloping a lot, **3** – vertical or almost vertical

\*\*\*\***1** = 0-0,05 m/s    **2** = >0,05-0,1 m/s    **3** = >0,1-0,2 m/s    **4** = >0,2-0,4 m/s    **5** = >0,4 m/s

**ANNEX III**  
**3. The Table of Ammocoetes**

Sample Nº	Length, mm	Notes	Sample Nº	Length, mm	Notes	Sample Nº	Length, mm	Notes

## ANNEX IV

Sampling site ID	Catchment area	River	Coordinates		Sampling site ID	Catchment area	River	Coordinates	
1	Bārta	Ruņa	56.3918	21.64502	41	Gulf of Riga	Grīva	57.38378	23.016
2	Užava	Užava	57.16479	21.495	42	Gulf of Riga	Roja	57.5345	22.69143
3	Venta	Venta	57.00917	21.97864	43	Gulf of Riga	Roja	57.52414	22.68078
4	Venta	Venta	56.99362	21.96437	44	Gulf of Riga	Roja	57.43722	22.72129
5	Venta	Venta	56.98025	21.97109	45	Gulf of Riga	Melnsilupe	57.63698	22.56709
6	Venta	Venta	57.04636	21.92366	46	Gulf of Riga	Pilsupe	57.57716	22.62659
7	Venta	Rudupe	57.05431	21.92657	47	Baltic Sea	Lonaste	57.5172	22.1258
8	Venta	Abava	57.10655	22.04879	48	Venta	Venta	57.10343	21.79294
9	Venta	Abava	57.07595	22.47525	49	Venta	Vēždūka	57.27648	21.77654
10	Venta	Riežupe	56.99549	22.00959	50	Venta	Kamārce	57.3545	21.6231
11	Venta	Riežupe	57.0085	21.98085	51	Užava	Kauliņa	56.98361	21.54987
12	Baltic Sea	Raķupe	57.4451	22.19	52	Užava	Vanka	57.04462	21.61469
13	Baltic Sea	Pāce	57.4762	22.183	53	Baltic Sea	Rīva	56.96538	21.35137
14	Baltic Sea	Irbe	57.55183	21.86743	54	Saka	Tebra	56.83435	21.34029
15	Baltic Sea	Irbe	57.61014	22.08286	55	Saka	Tebra	56.78311	21.55678
16	Baltic Sea	Mazirbe	57.67	22.2978	56	Saka	Durbe	56.83382	21.22769
17	Baltic Sea	Pitragupe	57.7016	22.3774	57	Saka	Durbe	56.76742	21.27872
18	Baltic Sea	Pitragupe	57.6883	22.3774	58	Baltic Sea	Rīva	56.92215	21.37217
19	Gulf of Riga	Pilsupe	57.5417	22.5086	59	Bārta	Vārtāja	56.52936	21.4567
20	Gauja	Gauja	57.47055	25.39902	60	Bārta	Virga	56.43026	21.44368
21	Gauja	Gauja	57.3128	25.2253	61	Lielupe	Bērze	56.68416	23.50273
22	Gauja	Gauja	57.2548	25.0439	62	Lielupe	Misa	56.68512	24.31161
23	Gauja	Gauja	57.36155	25.30586	63	Lielupe	Iecava	56.64093	24.025
24	Gauja	Gauja	57.15448	24.83299	64	Gulf of Riga	Lielā Jugla	56.9705	24.4906
25	Gauja	Amata	57.2613	25.1389	65	Gulf of Riga	Mazā Jugla	56.9038	24.4575
26	Gauja	Amata	57.246	25.1428	66	Gulf of Riga	Pēterupe	57.25736	24.42009
27	Gauja	Līgatne	57.2486	25.0505	67	Gulf of Riga	Pēterupe	57.26022	24.41582
28	Gauja	Rauna	57.36266	25.37321	68	Gulf of Riga	Pēterupe	57.2423	24.4831
29	Gauja	Strīkupe	57.37936	25.26311	69	Gulf of Riga	Aģe	57.31835	24.41973
30	Gauja	Lorupe	57.13586	24.80466	70	Gulf of Riga	Aģe	57.32433	24.4742
31	Gauja	Gauja	57.51988	26.39104	71	Gulf of Riga	Ķīšupe	57.27775	24.41993
32	Gauja	Gauja	57.6184	25.70056	72	Gulf of Riga	Liepupe	57.46444	24.40598
33	Gauja	Vecpalsa	57.4621	26.3479	73	Gauja	Vecpalsa	57.45484	26.24883
34	Gauja	Rauza	57.41235	26.15231	74	Salaca	Korģe	57.77248	24.51986
35	Salaca	Salaca	57.83577	24.73797	75	Gulf of Riga	Svētupe	57.71557	24.43562
36	Salaca	Salaca	57.87771	24.59155	76	Gulf of Riga	Svētupe	57.68932	24.65114
37	Salaca	Salaca	57.85803	24.50338	77	Gulf of Riga	Zakupīte	57.49101	24.40134
38	Salaca	Salaca	57.75823	24.45071	78	Gauja	Gauja	57.0808	24.3386
39	Salaca	Korģe	57.75831	24.45123	79	Gauja	Gauja	57.12618	24.65557
40	Gulf of Riga	Vitrupe	57.65061	24.44659	80	Gauja	Gauja	57.36088	26.51341