

Guidelines for flatfish juveniles survey using beach seine

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The aim of the research survey is to count turbot and flounder juveniles (age groups 0+ and 1-year-old juveniles) in the coastal zone. The beach seine is the most suitable fishing tool for this purpose, allowing the sampling of the coastal area from a few centimeters to 2-3 meters deep, the zone where turbot juveniles stay during the summer period.

Below are the main guidelines for conducting juvenile fish surveys using the research beach seine and turbot juvenile net in the coastal area, as well as the analysis of obtained samples in the laboratory. Since juvenile fish surveys are conducted using two different fishing tools, their specifics are described separately.

1. Beach Seine

The parameters of the fishing gear are as follows: horizontal opening - 7 m, vertical opening - 1 m, mesh size in the body - 5 mm, mesh size in the wings - 10 mm, length of towing ropes - 150 m, diameter - 20 mm. The towing ropes are made of jute spiral rope (the rope material must ensure good sinking to the bottom). One net haul covers an area of approximately 4000 m².

Surveys are conducted at five locations along the coast:

1. In Kolka, on the bay side (surveys are conducted to the south of Cape Kolka, in the Gulf of Riga).
2. In Kolka, on the open sea side (surveys are conducted to the west of Cape Kolka, in the Irbe Strait).
3. In Lielirbe (surveys are conducted to the southwest of the Irbe River estuary).
4. In Jūrmalciems (surveys are conducted to the south of Jūrmalciems Harbor).
5. In Papē (surveys are conducted in the area between the Papē lighthouse and the pier) (see Figure 1).

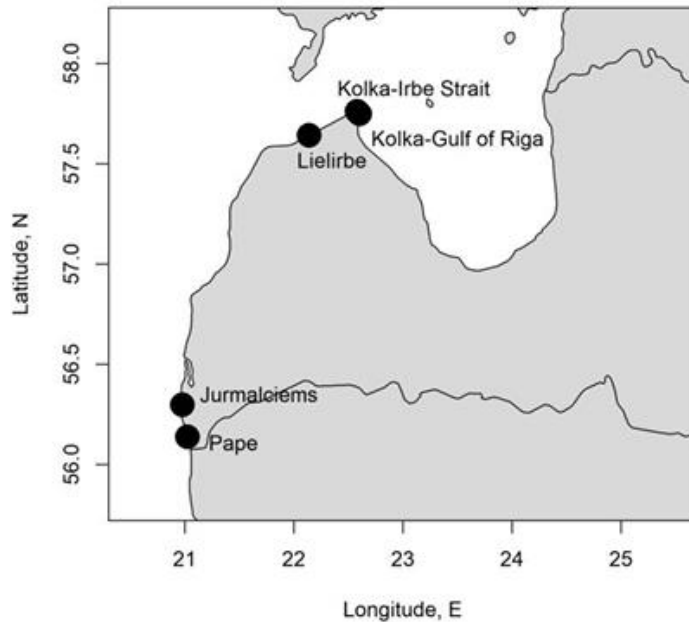


Image 1. Locations of survey stations for research fishing with juvenile beach seine.
(● - survey stations)

The counting of flatfish juveniles using beach seine in the mentioned locations is carried out once during the spring season (from mid-May to mid-June) and once during the summer season (from July to August). The timing of the counts mainly depends on meteorological conditions (minimum wind strength and wave height).

At each counting location, 5 repetitions are performed (the number of repetitions may vary due to unfavorable weather conditions and technical reasons). The distance between the performed repetitions is 100-200 m. The beach seine is deployed from a rowboat. The distance between the towing rope lines is approximately 30 m. The maximum distance from the shore is 140 m, and the water depth is up to 2.5 m. The beach seine is pulled ashore by hand. The approximate towing speed of the seine is 30 m/minute.

A fieldwork protocol for the beach seine (see Appendices 1 and 2) is completed for each repetition, indicating the seine pulling date, location, time, repetition number, meteorological conditions, wave height, seine towing depth, water hydro-chemical parameters (temperature, salinity, and oxygen saturation, measured at the time of seine deployment with a hydrological probe), water transparency or Secchi depth (measured with a Secchi disk). The protocol lists all fish species and other organisms found in the seine.

On the other side of the protocol, fish longer than 15 cm are recorded, indicating their species, length (with an accuracy of up to 1 mm), and weight (with an accuracy of up to 0.5 grams). For turbot and flounder, gender is also determined. Other fish less than 15 cm in length and other living organisms are placed in fine mesh bags (<1 mm) with annotations indicating the seine pulling date, location, and repetition number. They are fixed in a 70% ethanol solution for further laboratory analysis.

If a significant quantity (>500 g) of one fish species (excluding turbot and flounder) of individuals smaller than 15 cm (usually sandeels, herring, smelt, etc.) is found during the survey, the total weight of this species of fish is recorded in the protocol. A subsample (not less than 50 fish) is taken from this catch, and their weight is also recorded. The subsample, along with the rest of the catch, is preserved in ethanol for further laboratory analysis.

Analysis of the samples obtained in the laboratory

The analysis of the samples obtained in the beach seine is conducted in the laboratory. If the sample is very sandy or contains stones, it is carefully rinsed through a sieve and thoroughly dried to prevent changes in the fish's weight. Fish are sorted by species, and separately, zoobenthic organisms (shrimps, amphipods, mysids, etc.) are identified. All obtained information is recorded in the beach seine analysis protocol (see Appendix 3). At the top of the protocol, the location of the seine, date, number of fishing activity, and the total weight and quantity of individuals of one species are indicated.

The precision of length measurements for all fish is 0.05 cm, while for weight, it is 0.01 g. Fish measurements are conducted as follows:

1. For turbot and flounder: Length and weight measurements are taken for all individuals, regardless of their quantity in the sample. Additionally, sex is determined (females, if their ovaries are clearly visible deep inside the body cavity when held up to the light; this can also be confirmed by making an incision). This information is recorded in the protocol under the "Sex" section, with "Male" (1), "Female" (2), or "(j)" (for fish in too early a stage of development to visually identify their gender).

2. Other Fish Species:

- If there are fewer than 50 individuals of a single species in the sample, measure and record the individual length and weight of each of them.
- If there are 50 or more individuals of a single species in the sample, refer to the corresponding fieldwork protocol. If the total weight of this species of fish, which was recorded at the coastal site, is mentioned in that protocol, then record this weight in the upper part of the laboratory analysis protocol. Additionally, record the weight of the subsample (the portion collected for laboratory analysis). If such a record is not present,

then weigh all the fish of this species collected during the haul and record their total weight. If there are more than 50 individuals of a single species in the sample, individually measure and weigh 50 of them. Leave the count field empty; it will be calculated proportionally based on the total weight of this species of fish.

3. Other Living Organisms:

In the upper part of the protocol, specify the taxonomic group, the total count, and the total weight of each living organism.

If there are many individuals of a single species, take a subsample (20-30 organisms), record the total weight of all individuals, as well as the count and weight of the subsample, in the protocol.

All protocols, both fieldwork and laboratory analysis, should be organized by location and date. When entering data, perform the necessary calculations (especially for subsample counts). Ensure data quality by creating plots or graphs for each species, verifying the relationship between length and weight, and correcting any erroneous entries.

Flounder juvenile seine

The parameters of the fishing gear are as follows: horizontal opening - 12 meters, vertical opening - 1.5 meters, mesh twine eye size - 5 millimeters, mesh wing twine eye size - 8 millimeters, length of towing ropes - 15 meters, and diameter - 10 millimeters. The area covered by a single gear haul is approximately 300 square meters.

Counts of juveniles using the flounder beach seine net are conducted in two coastal locations:

- In Kolka, on the open seaside (counts are conducted to the west of Cape Kolka, in the Irbe Sea Strait).
- In Pape (counts are conducted in the area between Pape Lighthouse and the pier).

Fish juveniles counts using the flounder beach seine net are done once during the summer season, from July to August inclusive. The timing of the counts mainly depends on meteorological conditions, with a minimum wind strength and wave height required.

At each counting location, the net is pulled by hand parallel to the shore in three different depth zones (0.2 meters, 0.6 meters, 1 meter), with 4 repetitions performed in each depth zone (the number of repetitions may vary due to unfavorable weather conditions and technical reasons). The distance between the repetitions is 100 meters.

Information is recorded in the flounder juveniles beach seine net protocol (see Appendix 4), which includes the date of net hauling, location, time, repetition number, meteorological conditions, depth zone, water hydro-chemical parameters (temperature, salinity, and oxygen saturation, measured at the time of net deployment with a hydrological probe), water transparency or Secchi

depth (measured with a Secchi disk), as well as a visual assessment of the type and percentage distribution of the bottom substrate. The protocol also specifies all fish species and other organisms found in the net. Fish and other living organisms are sorted by species, and the total number and weight of each species are determined.

If more than 50 individuals of a single species are found in the haul (excluding flounders and turbot), the protocol records the total weight of this species of fish, and a subsample (not less than 50 fish) is taken, with the number and weight of fish in the subsample recorded.

Flounders and turbot caught in the haul (excluding adult individuals, which undergo individual length and weight measurements) are placed in fine mesh bags (or equivalent) with a mesh size of less than 1 millimeter. These bags are labeled with the date of net hauling, location, depth zone, and repetition number, and they are preserved in approximately 70% ethanol solution for further laboratory analysis.

Analysis of the data obtained from flounder juveniles beach seine net samples in the laboratory.

Analysis of the data obtained from flounder juveniles beach seine net samples in the laboratory involves taking length and weight measurements of all individuals in the sample, regardless of their quantity. The precision of length measurements for fish is 0.05 centimeters, while for weight, it is 0.01 grams. Additionally, the gender of each fish is determined. If the fish are mature, their ovaries are visually identified (by holding them up to the light), or ovaries are identified by making an incision. This information is recorded in the protocol, indicating the respective categories: male (1), female (2), or (j) if the fish is in too early a stage of development for visual gender identification.

Two otoliths (sagitta) are removed from each fish and placed in a paper envelope. The envelope is labeled with the date of net hauling, location, repetition number, and depth zone. Each envelope page contains the fish's sequence number and biological information (length, weight, gender).

In the laboratory, the information is transcribed onto a biological analysis form and entered into a computer. During data entry, necessary calculations are performed (including the number of individuals, if a subsample is taken). Data quality is checked by creating plots for flounders and turbot, verifying the length-to-weight ratio, and correcting any erroneous entries.

Determining the Data Accuracy Level

To determine data accuracy, three levels of precision are used:

- Level 1 - The assessable parameters can be estimated with a precision of $\pm 40\%$ using a 95% confidence interval or achieving approximately 20% of the coefficient of variation.
- Level 2 - The assessable parameters can be estimated with a precision of $\pm 25\%$ using a 95% confidence interval or achieving approximately 12.5% of the coefficient of variation.
- Level 3 - The assessable parameters can be estimated with a precision of $\pm 5\%$ using a 95% confidence interval or achieving approximately 2.5% of the coefficient of variation.

The precision of catch length and age distribution, as well as biological parameter precision, for assessable fish stocks must be calculated by quarters and fishing gears. Afterward, the overall precision is calculated as the weighted average. The attainable precision level depends on the species under study.

Calculation of Precision Levels

For the calculation of precision levels, two methods are employed: the bootstrap method and the analytical method.

Bootstrap Method for Precision Level Calculation

The bootstrap method is primarily used for calculating 95% confidence intervals and assessing precision levels. The bootstrap method assumes that the observed parameter, such as the distribution of fish lengths in a sample, represents the distribution of values for the entire population from which the sample was obtained. From the obtained sample dataset, 2000 random pseudo-samples are generated. For each of these pseudo-samples, the mean value for the specific parameter is determined. The 2.5th and 97.5th percentiles from these 2000 pseudo-samples are then used as the 95% confidence interval for the population parameter's mean value.

Analytical Method for Precision Level Calculation

For certain parameters, such as the mean weight of fish in each age class, the 95% confidence interval and, consequently, the precision level were calculated analytically using the formula:

$$\hat{\mu} \pm t(n-1)_{\alpha} \cdot s / \sqrt{n},$$

Where:

μ is the estimated parameter mean value,

n is the number of observations (fish) in the specific class,

t_{α} is the two-tailed t-distribution value at the confidence level α ,

σ is the standard error of the mean

This formula is used for certain parameters, such as the mean weight of fish in each age class, where $t_{(n-1)\alpha}$ represents the two-tailed t-distribution value corresponding to the confidence level α and $n-1$ degrees of freedom, while \sqrt{n} represents the standard error of the mean.

Appendix

Flatfish Juveniles Beach Seine Field Work Protocol, Page 1.

Zivju mazuļu vadiņa protokols

Datums _____ Vietas nosaukums _____ Laiks _____

Koordinātas _____ Betiskais Pelagiskais NR

Vēja virziens stiprums Mākoņainība % Vīļu augstums cm Dzijums

Sāļums Gr V Ūdens t Gr V Skābeklis Gr V

Paraugā konstatētas zivju sugas	Piezīmes
1 _____	_____
2 _____	_____
3 _____	_____
4 _____	_____
5 _____	_____
6 _____	_____
7 _____	_____
8 _____	_____
9 _____	_____
10 _____	_____
11 _____	_____
12 _____	_____
13 _____	_____
14 _____	_____
15 _____	_____

Paraugā konstatētie citi dzīvie organismi

1 _____	
2 _____	Datus ievadīja _____
3 _____	
4 _____	
5 _____	

Uz vietas izanalizētās zivis

Nr	Suga	Garums	Svars	Dzimums	Stadija
1					
2					
3					
4					
5					
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7					
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