

Guidelines for Scientific Survey of Turbot

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The aim of the research survey is to assess the abundance of turbot nursery areas within the Latvian economic zone. The survey results complement the data from the first and fourth quarters of the Baltic International Trawl Survey (BITS) for use by the ICES (International Council for the Exploration of the Sea) scientific advisory process. The survey results are also utilized in coastal fisheries management to determine the allowable number of fishing gear units. The survey is conducted using large-sized (240 mm mesh size) bottom nets, identical to those used in coastal commercial fisheries targeting turbot.

Below are the main guidelines for conducting scientific survey of turbot with bottom nets, as well as the analysis of collected samples in the laboratory:

1. Turbot nets:

Net parameters: net height – 1.5 m, net length – 60 m, mesh size (diagonally) – 240 mm, and the number of nets used should not exceed 100. The nets are deployed in coastal waters at depths ranging from 3 to 20 meters. The total duration of fishing is 10 days in June and 10 days in July. Three fishing sets are conducted each month, with each fishing set lasting 48 to 96 hours. For each survey, the fishing log records the date and time of net deployment and retrieval. When calculating the turbot nursery index, the catch is standardized to a 24-hour period.

Surveys are conducted in the Latvian coastal zone, starting from Pavilosta Port. Minimal damage to the nets is permissible during the survey. The suitability of nets for subsequent surveys should be assessed after each fishing set. In the fishing log ("Notes" section), any damages to the nets caused by seals or other factors should be recorded. If a net is significantly damaged, it should be replaced with a new one. These guidelines ensure the collection of accurate data for the assessment of turbot populations in the Latvian economic zone, which is crucial for scientific and fisheries management purposes.

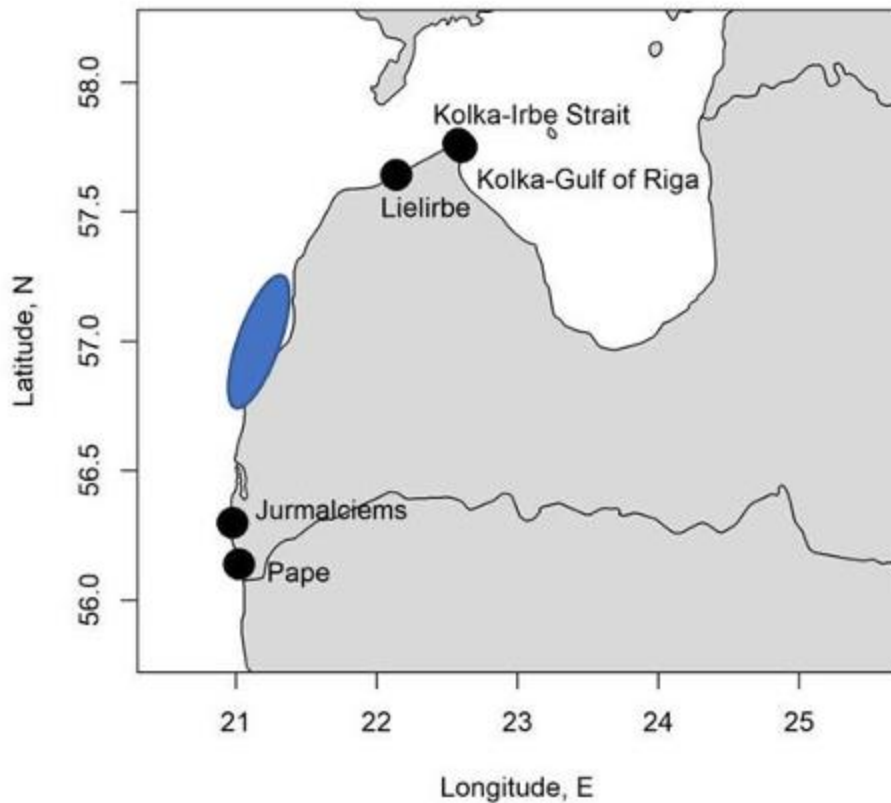


Figure 1. Study area for turbot spawning stock survey (highlighted in blue)

2. Net Fishing Survey

Information for each net fishing event is recorded on a special net fishing survey card (see Appendix 1), which includes details about each fishing operation, the survey number, vessel registration number or vessel name, parameters of the fishing gear used, information about the sampling location, fishing duration, and details about the composition of the catch by species, in both kilograms and numbers.

3. Meteorological Conditions and Water Parameters

In each survey, meteorological conditions and water temperature are recorded in the survey protocol, both during the deployment and retrieval of the fishing gear. Meteorological parameters such as wind direction and speed (m/s) are also recorded during the process of deploying and retrieving the gear. All this information should be indicated only on the net fishing survey card.

4. Catch Processing

Captured fish are removed from the net nets and individually analyzed by species. Turbots undergo a complete biological analysis. The length of each fish is measured from the snout to the tip of the tail fin. The fish's mouth must be closed, and the tail fin should not be stretched (see Figure 2).

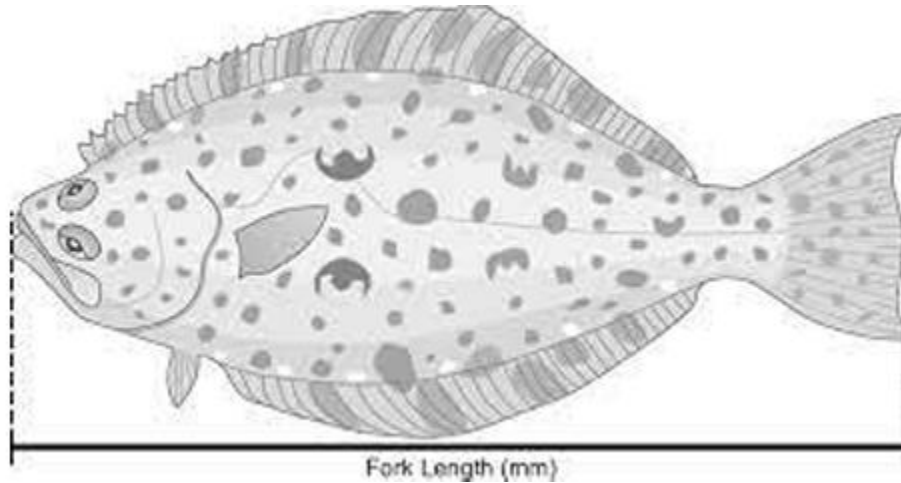


Figure 2. Length measurement of a turbot

The length is measured in centimetres with a precision of 0.1 cm (e.g., 24.7 cm). The weight of the fish is measured in grams with a precision of 1 gram (e.g., 169 grams). For turbot, gender and gonad maturity stage are determined using a seven-point scale, which is supplemented by a standard six-point scale. Descriptions of the stages are visible in Table 1.

Table 1. The comparison of two Baltic cod maturity assessment scales

Gonadal state	7 stage scale (Nikolsky,1944, Powles,1958)
Immature	II
Maturing	III
Mature	IV
Ripe and running	V
Spent	VI
Deformed	VII

- Nikolsky G.V. 1944. Biology of fishes (in Russian).
- Powles, P.M. 1958. Studies of reproduction and feeding of Atlantic cod (*Gadus callarias* L.) in the south-western Gulf of ST. Lawrence. J. Fish. Res. Bd. Canada, 15(6)

Every year during this expedition, 300 turbot otoliths are collected for later age determination in the laboratory. Two otoliths (sagitta) are taken from each fish and wrapped in a paper envelope. The envelope is labelled with the fishing time, the name of the vessel, the location, and the species name. Each envelope page is marked with the individual fish serial number and provides biological information (length, total weight, gender, and maturity stage). In the laboratory, the information is transcribed onto a biological analysis form (Attachment 2) and entered into a computer database. Turbot otoliths are taken to represent all length groups and create an age-length key (ALK key). During the biological analysis, any fish found in the stomachs are visually recorded (if possible, identified by species and length). For other turbot for which a full biological analysis is not conducted, the length is measured, gender and gonad maturity stage are noted. For bycatch species, their length and total weight are measured by species.

5. Recording of Other Animals, Rare Fish Species, and Seal Damage:

Seal Damage: During each fishing operation, the number of seals observed should be noted when setting and retrieving the nets. If any damage to the catch by seals is observed (e.g., only fish heads remain in the nets), this should also be recorded in the protocol, specifying the fish species that have been damaged and the approximate quantity at each station. If damaged fish, such as pikeperch, salmon, trout, smelt, or perch, are found in the nets, only the length of the head from the snout to the outer edge of the gill cover should be measured (see Figure 2). In the "Notes" section of the protocol, it should be noted that the fish has been damaged by a seal.

Birds: Captured birds in the nets should be photographed in a way that clearly shows their head and upper wing. One bird can appear in multiple photographs. Information about the captured birds should be recorded in the fishing protocol, and the photographs should be sent to "BIOR" through one of the following methods: printed form (see address in section 6), electronically (ivars.putnis@bior.lv)

Rare Fish Species, Crabs: If crabs or lesser-known and rare fish species (such as mackerel, anchovy, haddock, sea cucumbers, barbel, fathead minnow, stickleback, etc.) are caught in the nets or if it is impossible to determine the fish's species, they should be frozen (with a note indicating the fishing date and station number) and later handed over to "BIOR" staff. All this information must also be recorded in the "Special Notes and Other Information" section of the fishing protocol.

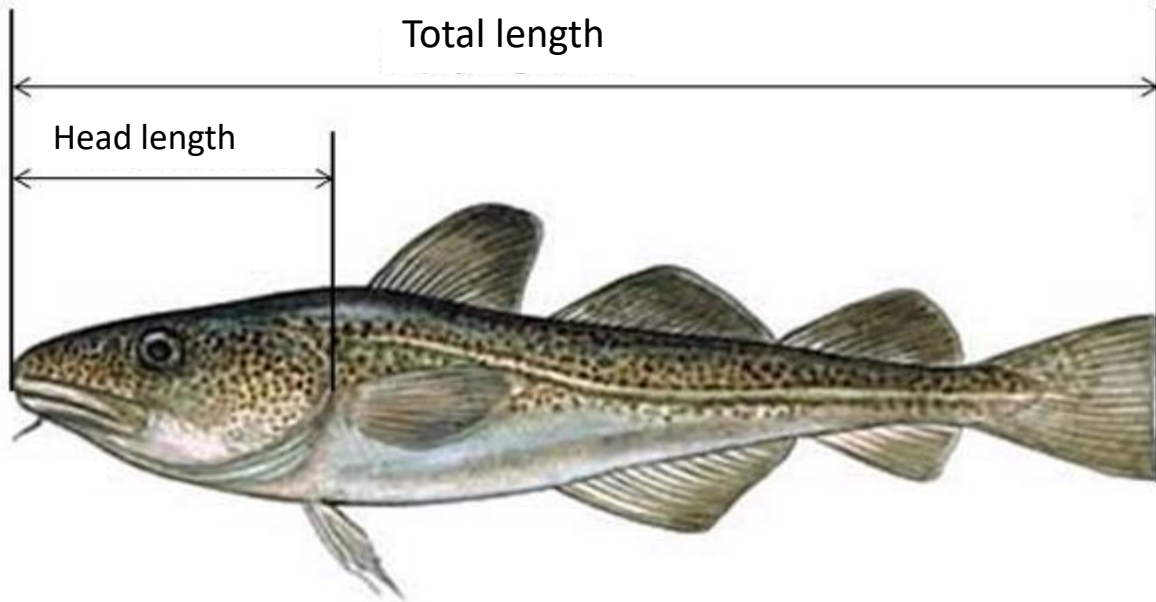


Figure 3. Measuring the head length of pikeperch, salmon, trout, whitefish, and cod in cases of damage caused by seals.

6. 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:

$\hat{\mu}$ 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 1.

Tīklu zvejas uzskaites kartiņa

Reisa No	3005	Datums_1	D 18	M 6	G 19	<input type="checkbox"/> Diena <input type="checkbox"/> Nakts
Zvejas akta No	1	Datums_2	D 21	M 6	G 19	
Apakšrajons	28	Kuģa No	Reina			<input type="checkbox"/> Rūpnieciskā zveja <input checked="" type="checkbox"/> Pētnieciskā zveja
Zona		Zvejas rīks	GNS			
LV kvadrāts	434	Acs izmērs, mm	240			
		Zvejas ilgums, minūtēs	4680			
		Izejas logs	0			

Vēja virziens Vēja stiprums, m/s Viļņošanās Kļūmes

	Koordinātes		Dziļums m	Zvejas ilgums				Temperatūra	Piezīmes
	Grādi	Minūtes		Izlikšana		Izņemšana			
				St.	Min.	St.	Min.		
Platums	56	43	18	12	00	18	00		
Garums	20	59							

Tīklu skaits

Acs izmērs, mm	Garums	Augstums	Skaits
240	60	1.5	100

No	Zivju suga	Svars, kg	Zivju skaits	Nozvejas kategorija	Derīgums	Piezīmes
1	Akmeņplekste	92	125	landing	1	
2	Akmeņplekste	31	76	discard	1	
3	Plekste	3.1	10	landing	1	
4	Menca	3.95	3	landing	1	
5	Menca	0.6	2	discard	1	
6						
7						
8						

