

Collection of Biological Data in Commercial Fishing in the Baltic Sea

Handbook for observers Working on Latvian Fishing Vessels in the Baltic Sea

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1. Introduction

The Food Safety, Animal Health, and Environmental Scientific Institute BIOR, Department of Fish Resources Research, Sea Division, conducts fish resource research work in the Baltic Sea and the Gulf of Riga. They organize research, control, and monitor trips and collect analyses from commercial fishing catches. This document describes how and what biological information is collected from Latvian fishing vessels/boats engaged in fishing in the Baltic Sea. The handbook can be used in specialized trawl and net fishing as well as in compiling information from coastal fishing where stationary fishing gear or towed lines are used.

2. Assessment of Fish Stocks

The main commercially important fish species - cod, sprat, herring, and flatfish stocks in the Baltic Sea are assessed by the International Council for the Exploration of the Sea (ICES). The assessment of cod, sprat, herring, and flatfish stocks is carried out by ICES Working Group on Baltic Fisheries Assessment (WGBFAS), with the participation of specialists from all Baltic Sea countries and using data prepared by these countries on fish catches and research surveys.

The main reason for collecting data from commercial fishing is to provide WGBFAS with the necessary information for fish stock assessments. Although fish stock assessments are conducted only for specific fish species (cod, flatfish, sprat, and herring), information needs to be collected for all fish species caught during commercial trips (Table 1).

Table 1. List of Fish Species Caught in Baltic Sea Commercial Fishing Trips

Suga	FAO 3-alfa kods	Laitiniskais nosaukums	Garuma1 kods	WoRMS_kods
Rer:(le	HER	<i>Clupea harengus</i>	0.5 cm	126417
Bretlioā	SPR	<i>Sprattus sprattus</i>	0.5 cm	126425
Menca	COD	<i>Gadus morhua</i>	cm	126436
Plekste	FLE	<i>Platichthys flesus</i>	cm	127141
Pilicis	AIBK	<i>Blicca bjoerkna</i>	am	154274
Tiibite	AIBZ	<i>Ammodytes tobianus</i>	am	126752
Kisis	ACC	<i>Gymnocephalus cernuus</i>	am	151302
V ke	ALR	<i>Alburnus alburnus</i>	om	1542.85
Ehnioas a111sovs	AINE	<i>Engraulis encrasicolus</i>	am	126426
Zubis	ELE	<i>Anaema anaema</i>	am	126281
Lucibis	EILP	<i>Zoarces viviparus</i>	am	127123
JCirasvedzele	EINIC	<i>Enchelyopus cimbrius</i>	am	126450
Pilaudis	FBM	<i>Abramis brama</i>	om	1542.81
Vedzele	FIBU	<i>Lota lota</i>	am	154.388
Ka11Cisa	FCC	<i>Carassius carassius</i>	am	154297
Kama	IFCP	<i>Cyprinus carpio</i>	am	154582
Allants	FIID	<i>Leuciscus idus</i>	am	154324
Baltais sa1roals	FIE	<i>Leuciscus leuciscus</i>	am	154599
Asaris	FPE	<i>Perea fluviatilis</i>	om	151.353
Udaka	IFPI	<i>Esox lucius</i>	am	154210
Za,ndarts	FPP	<i>Sander lucioperca</i>	am	151308
Ra11Jda	FRO	<i>Rutilus rutilus</i>	am	154333
Lillis	FTE	<i>Tinca tinca</i>	am	154343
Vejs1ivs	GAR	<i>Belone belone</i>	om	126.375
P1ik?la	HAID	<i>Melanogrammus aeglefinus</i>	am	126437
Za,kziv1is	LUM	<i>Cyclopterus lumpus</i>	am	127214
Atlanbi1as makrelle	MAC	<i>Scomber scombrus</i>	am	127023
Cetra,au bu Uzivs	MOS	<i>Moxocephalus aquadricornis</i>	am	254529
Z1iem1u bullzivs	MXV	<i>Moxocephalus scorpius</i>	am	127203
A1oalais 1Cira,sarundu 1lis	NIBU	<i>Neoobius melanostomus</i>	om	126916
Jorasarundulis	OIBD	<i>Pomatoschistus microstomus</i>	am	126927
JCiras ze 1tplekste	PLE	<i>Pleuronectes platessa</i>	am	127143
Siaa	PILN	<i>Coregonus lavaretus</i>	am	127180
Sa,ida	POK	<i>Pojlachius virens</i>	am	126441
Lasi:s	SAL	<i>Salmo salar</i>	om	127186
Sa,la ka	SME	<i>Osmerus eperlanus</i>	am	126736
IR11Jdl1Jlis	SRE	<i>Scardinius erythrophthalmus</i>	am	154165
Taimios	TRS	<i>Salmo trutta</i>	am	127187
Pa,lede	TSD	<i>Alosa fallax</i>	am	126415
Alkmeno,lelkste	TUR	<i>Scophthalmus maximus</i>	am	127149
Viimlba	VIV	<i>Vimba vimba</i>	om	283150
Merlanas	WGH	<i>Merluccius merluccius</i>	am	126438
IN1igilios	YIEZ	<i>Hvoerooolus janceolatus</i>	am	126756

3. Data Collection on Fishing Vessels

3.1. Information about the Trip, Fishing Vessel/Boat, and Fishing Activity

Each trip is based on information about the trip, vessel/boat, and fishing activities. This information is compiled in trip reports and fishing log sheets. For each trip, the following information is collected:

- Vessel name and registration number.
- Trip number.
- Main engine power of the vessel in kW.
- Length overall (Loa) of the vessel in meters.
- Gross tonnage (GT) of the vessel.
- Departure/return port of the vessel and respective dates.
- Target species for the trip (applies to specialized sea fishing).
- Fishing gear used.
- Size of the fishing gear (mm).
- For net fishing, the number of fishing gear used. If different mesh sizes of nets are used, the number of nets in each size group is specified.
- For bottom trawl fishing, the type of exit window.
- Name and surname of the observer.
- Notes.

Each trip is assigned a unique trip number. The observer can use their own trip numbering system or use the numbering (trip code) assigned to each individual trip by the BIODATA biological data recording information system. If the latter option is chosen, it is recommended to register the trip in the BIODATA system before heading to sea.

Fishing gear is marked with a code specified in the BIODATA fishing gear classifier (Table 2).

Table 2. Fishing gear classification with corresponding 3-letter codes.

Name	Fishing gear code
Longlines (drifting)	LLD
Set longlines	LLS
Driftnets	GND
Set (anchored) gillnets	GNS
Danish seines	SDN
Fish traps	FIX
Pound nets	FPN
Weir	FWR
Pots (traps)	FPO
Bottom otter trawls	OTB
Midwater otter trawls	OTM
Bottom pair trawls	PTB
Pelagic pair trawls	PTM
Fyke net	FYK
Fish pots	FFN
Herring nets	GNH
Turbot nets	GNT

Hooks	HOK
Fishing nets	NET
Gill nets	GN
Gear not known	NK
No gear	NO
Otter trawls	OT
Seine nets (nei(SX
Trawls	TX

The observer needs to know the vessel's name or registration number. The vessel's registration number, main engine power in kW, vessel tonnage, and vessel length in meters can be obtained by using the data from the Latvian Ship Register, which is available in the Latvian Fisheries Integrated Control Information System (LZIKIS): <https://lzikis.zm.gov.lv/LZKR/Vessel/List>, or by consulting with employees from **Information and Data Department of the Food Safety, Animal Health, and Environmental Science Institute "BIOR" Fisheries Research Department.**

If the vessel's departure or return location is a foreign port, the country where that port is located is also indicated (Table 3).

Table 3: Fishing Ports Used by Latvian Fishermen.

Osta	Valsts	Valsts kods
Rīga	Latvija	LVA
Ventspils	Latvija	LVA
Liepāja	Latvija	LVA
Kolka	Latvija	LVA
Salacgrīva	Latvija	LVA
Skulte	Latvija	LVA
Roja	Latvija	LVA
Pāvilosta	Latvija	LVA
Engure	Latvija	LVA
Mērsrags	Latvija	LVA
Lielupe	Latvija	LVA
Ainaži	Latvija	LVA
Lapmežciems	Latvija	LVA
Nekse	Dānija	DNK
Ronne	Dānija	DNK
Kjoge	Dānija	DNK
Klaipēda	Lietuva	LTU
Vladislavovo	Polija	POL
Kolobrzeg	Polija	POL
Darlova	Polija	POL
Hela	Polija	POL
Gdańska	Polija	POL
Zasnic	Vācija	DEU
Karlskrona	Zviedrija	SWE
Ronehamne	Zviedrija	SWE
Vestervika	Zviedrija	SWE

3.2. Information about Fishing Activity

For each fishing activity, the following information is collected:

- Fishing activity number.
- Date.
- Start and end time of the fishing activity.
- Duration of trawling in minutes (optional parameter).
- Coordinates of the fishing activity (degrees, minutes).
- ICES fishing square, national fishing square, and fishing sub-area (optional parameters if fishing activity coordinates are available).
- Depth in meters.
- For pelagic trawl, the layer in meters where trawling takes place.
- Catch by species by catch categories (catch, discard, BMS).
- If possible, also collect information about wind direction in degrees and wind speed in m/s.

For each fishing activity, a separate data card is filled out (see Figures 1 and 2).

Traļu zvejas uzskaites kartiņa

Ileisa No	1005	Datums_1	D31	M5	G 18	<input type="checkbox"/> Diena <input type="checkbox"/> Nakts
Zas akta No	8	Datums_2	D31	M5	G 18	
Apakšrajons	26	KugaNo	VrTAS			<input type="checkbox"/> Rīl, pnieciska zveja <input type="checkbox"/> P 111 ieciskl z1, eja
Zona		Zvejas l'iks	018			
LV k6.drlls	877	Aas i.zmlrs, mm	120			
		Zvejas ilgums, minOl.lls	330			

Višļa virziens	Višļa stiprums, m/s	Višļa noa.rnls	Kiloms
4li	6		

	Koordīnātes		Dzīvnieks m	Zvejas ilgums				Temperatūra	Piezīmes
	Grlidi	Minntes		Izlikšana		Izmernsatta			
				St.	Min	St	Min		
Plarums	65	29							
Garums	18	32	86	16	JO	22	00		

No	Ziņu suga	Svars, kg	Ziņu skaits	Nozvejas kateorija	Delf.gums	Piezīmes
1	Menca	439	542	nozveja	1	
2	Menca	25	7g	BMS	1	
3	Piek.Ste	40	265	izmet..lls	1	
4						
6						
8						

ZNuslers un skaits 1 kast

Ziņu suga	Kastu skaits	SWIFS, kg	Ziņu skaits k:ast	Izm kateorija
Menca	Hi	25	36	0
Pjekste				0

Figure 1. Trawl Fishing Data Card with a Completion Example.

Tīklu zvejas uzskaites kartiņa

Reisa No	1011	Datums_1	D 14	M 6	G 16	<input type="checkbox"/> Diena <input type="checkbox"/> Nakts
Zvejas akta No	2	Datums_2	D 15	M 6	G 16	
Apakšrajons	26	Kuģa No	Dzintari			<input checked="" type="checkbox"/> Rūpnieciskā zveja <input type="checkbox"/> Pētnieciskā zveja
Zona		Zvejas rīks	GNS			
LV kvadrāts	947	Acs izmērs, mm	110			
		Zvejas ilgums, minūtēs	1440			

Vēja virziens	Vēja stiprums, m/s	Vilņošanās	Klūmes
80	5		

	Koordinātes		Dzīlums m	Zvejas ilgums				Temperatūra	Piezīmes
	Grādi	Minūtes		Izlikšana		Iznemšana			
				St.	Min.	St.	Min.		
Platums	55	25	76	18	00	18	00	Zvejas aktā 300 tīkli	
Garums	18	02							

No	Zivju suga	Svars, kg	Zivju skaits	Nozvejas kategorija	Derīgums	Piezīmes
1	Menca	380	416	Nozveja	1	
2	Menca	12	32	Izmetums	1	
3	Plekste	11	58	Izmetums	1	
4	Jūras zeltaplekste	0.74	5	Izmetums	1	
5						
6						
7						
8						

Zivju svars un skaits 1 kastē				
Zivju suga	Kastu skaits	Svars, kg	Zivju skaits kastē	Izmēra kategorija
Menca	13	25	32	0
Plekste				0

Figure 1. Net fishing data card with a completion example.

When summarizing information about the fishing location, the coordinates of the fishing activity (latitude degrees, latitude minutes; longitude degrees, longitude minutes) are a mandatory parameter. By using this information and maps (see Figures 3 and 4), it is possible to determine the fishing subregion, ICES fishing square, and national fishing square. If data is entered into BIODATA, after filling in the coordinates of the fishing location, the following fields are automatically populated: LV square; ICES square; ICES subdivision.

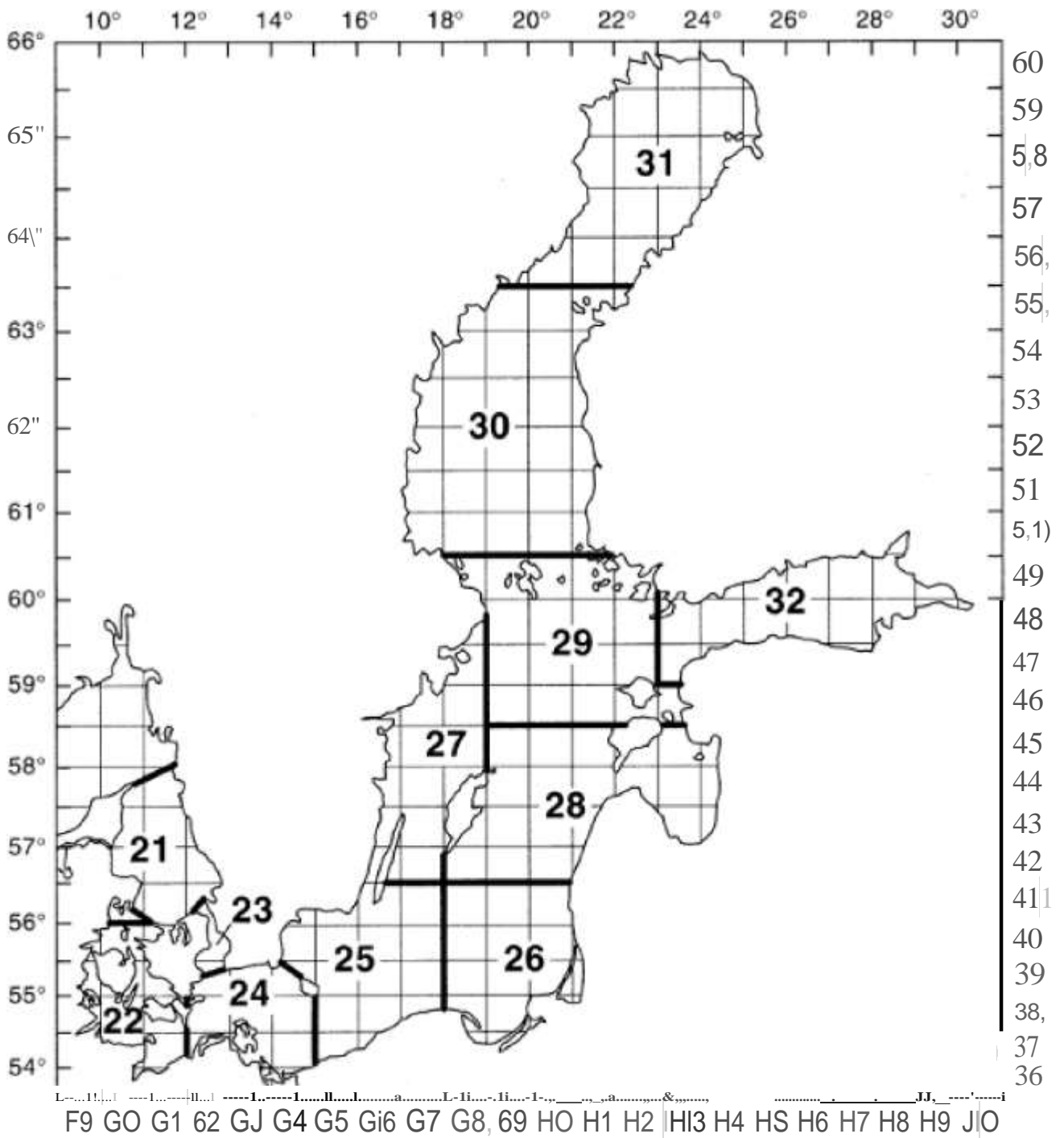


Figure 3. Map of the Baltic Sea with IECS subdivisions and ICES fishing squares

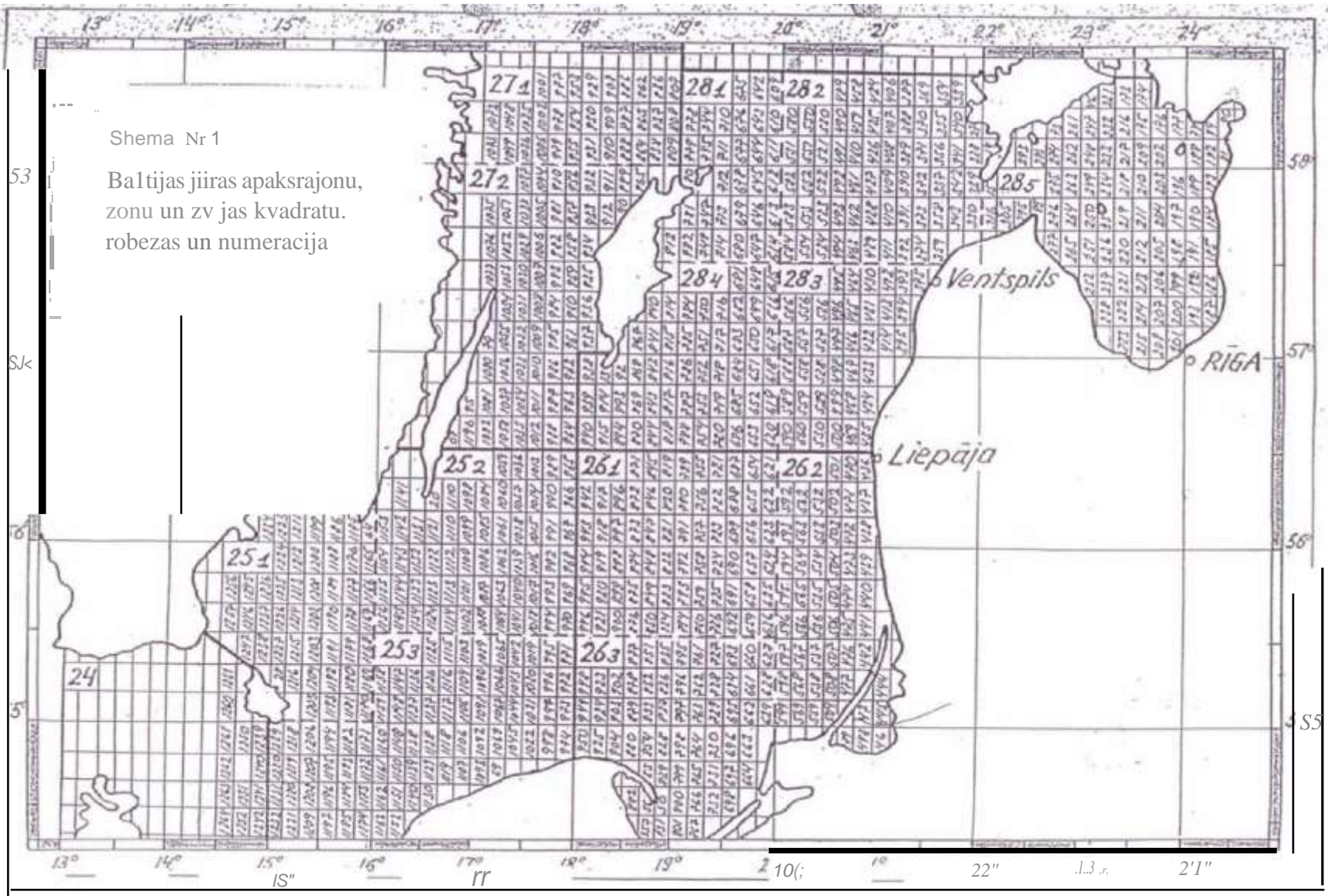


Figure 4. Map of the Baltic Sea with fishing subregions and national fishing squares.

3.3. Trawl Fishing

The start of trawling (fishing) is considered the moment when the trawl doors have reached the seabed, the trawl has assumed a stable position, and the vessel's speed is increased to the standard trawling speed.

Trawling ends when the trawl is lifted. If possible, the start and end coordinates of trawling are noted, along with the respective depths. The observer obtains this information from the vessel's captain.

3.4. Net Fishing

Date and time of net laying: This is the date and time when the entire net set is deployed into the water.

Date and time of net lifting: This is the date and time when the entire net set is retrieved. If only a portion of the previously deployed nets is lifted, then the time of net laying is when the laying of these nets was completed, not when the entire net set was deployed.

The number of fishing tools is the total number of nets used in the respective fishing operation.

3.5. Other Coastal Fishing Gear

Date and time of gear deployment: This is the date and time when the fishing gear is submerged into the water. If the fishing gear has been previously anchored at the fishing location, then the previous date and time of gear inspection should also be noted.

Date and time of gear retrieval: This is the date and time when the fishing gear is lifted.

3.6. Categories of Catch:

- **Catch:** The landed fish with a length above the minimum commercial fishing size.
- **BMS (Below Minimum Size):** Landed fish below the minimum industrial size and damaged fish.
- **Discard:** The observer's assessment of fish discarded by species (fish that are not landed and brought ashore). Discard includes small-sized, unhealthy, and poor-quality fish that do not meet market requirements. If possible, the discard should be indicated in kilograms. If the discard is substantial, it is advisable to specify the percentage of discard from the total catch.

3.7. Fish Count and Weight per Box:

This information is typically collected in commercial cod fishing, sometimes for plaice as well. In this section, you should specify how the cod is prepared for delivery, the weight of fish in one box, the number of fish in one box, and the number of boxes. If the fish are sorted into weight or length groups before weighing, the respective groups and the number of boxes in each group should be indicated.

3.8. Fish Suitability:

In this section, mark with "1" if biological information has been collected for the given species. If there is only information about the catch size for the given species, mark it with "4."

4. Collection of biological data on the vessel

Biological data is collected for all fish species caught during the trip. Information, if possible, is gathered for each fishing act, for all fish species, all catch categories (catch, discard, and BMS), and an estimate of the potential discard amount by species. Fish are sorted by species and catch category before analysis.

Biological analysis and length measurements are only performed for the main commercial species: cod, flounder, herring, and sprat. The length distribution is recorded for all other fish species from each haul. The number and weight of each species are determined, and if there is a small number of bycatch fish in the trawl, they are all measured. If it's not possible to measure all of them, a sample is taken and measured, and the total sample weight in kilograms is noted.

In pelagic trawl fishing, the composition of small pelagic fish species (such as herring, sprat, smelt, sickleback, etc.) is assessed by sorting one crate (30 kg) from the haul. In cases where only one species (e.g., herring or sprat) is predominant in the catch, it is acceptable to sort a smaller quantity (10 kg) from the haul. From the sorted crate, 200 herring and 200 sprat are selected for mass measurements and biological analysis. If there are fewer than 200 individuals of any species in the sorted crate, it is permissible to select the missing individuals from the remaining crate. For all other species present in the sorted crate, the total number, weight, and individual length measurements are recorded.

4.1. Biological Analysis

Biological analysis information is compiled on biological analysis cards (see figures 5.a and 5.b). Each catch fraction undergoes biological analysis on separate cards, specifying whether the fish are from discard or BMS. If there is no special notation on the card, the fish are analysed from the catch. The information on these cards duplicates the data from the catch cards.

Whenever possible, biological analysis involves randomly selected fish from each haul (fishing act). The total sample weight is recorded during the biological analysis. Usually, this quantity can be calculated after data entry.

Zivju bioloģiskās analīzes kartiņa					Lapu skaits	1	Lapas nr.	1				
Zivju suga	COD		Datums	25.06.2018		Parauga veids:						
Reisa No	1001		Kuģa No	2125		<input checked="" type="checkbox"/>	Rūpnieciskā zveja jūrā					
Zvejas akta No	1		Zvejas rīks	OTB		<input type="checkbox"/>	Pētnieciskā zveja	<input type="checkbox"/> BMS				
Apakšrajons	28		Acs izmērs, mm	110		<input type="checkbox"/>	Osta	<input type="checkbox"/> Bez atlasēs				
Zona			Zvejas ilgums	300		<input type="checkbox"/>	Izmetums	<input type="checkbox"/> Ar atlasi				
LV kvadrāts	500		minūtēs			Parauga svars, kg		5,630				
Loms, kg	300					Izmēra kategorija		Nešķīrotas				
No.	Garums, cm	Svars, g				Dzimums	Nobriešana	Kuņģa piepildījums	Tauku sat.	Vecums	Populācija	Rase
		Pilnais	Ķidātais	Aknas	Gonādas							
1	41	690				2	4					
2	37	520				2	5					
3	75	4420				2	5					
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

Figure 5a. Fish biological analysis card with an example of how to fill it out.

Zivju bioloģiskās analīzes kartiņa										Lappušu skaits	2	Lapas nr.	1	
Zivju suga	Renģe		Datums		13.04.2016		Parauga veids							
Reisa Nr.	4012		Kuģis		IRBE		<input checked="" type="checkbox"/> Rūpnieciskā zveja jūrā <input type="checkbox"/> Pētnieciskā zveja							
Zvejas akta Nr.	1		Zvejas rīks		OTM		<input type="checkbox"/> Osta <input type="checkbox"/> Izmetums							
Apakšrajons	28.1		Acs izmērs, mm		10		<input type="checkbox"/> Bez atlasē <input type="checkbox"/> Ar atlasē							
Zona	44H2		Zvejas ilgums, min		360		Parauga svars, kg							
LV kvadrāts	123		Roja, tralis							Izmēra kategorija				
Loms, kg	15000													
Nr.	Garums, cm	Svars, g		Dūmums	Stādīja	Vecums	Populācija	Rase	Kunga piepildījums	Trauku saturs	Svars, g			
		Pilnais	Kidbāts								Aknas	Gonādas		
1	10	6.5	5.8	2	1									
2	10	6.2	5.7	1	1									
3	10	6.8	6.1	2	1									
4	10	6.6	6	1	1									
5	10.5	7.2	6.5	2	1									
6	10.5	7.2	6.7	1	1									
7	11	7.9	7.2	2	1									
8	11	8.5	7.8	2	1									
9	11.5	9.5	8.6	2	2									
10	11.5	9.8	8.3	2	3									
11	12	9.6	9	1	1									
12	12	12.4	10.6	1	3									
13	12	12	9.9	1	4									
14	12.5	12.3	10.6	1	4									
15	12.5	12.1	11	2	2									
16	12.5	10.5	9.5	2	3									
17	12.5	13.2	11.8	2	3									
18	12.5	12.7	10.8	1	4									
19	12.5	14.5	12.2	1	4									
20	12.5	11.7	10.6	1	2									
21	12.5	12.2	11.3	1	2									
22	12.5	13.5	10.2	2	4									
23	12.5	13.5	12.1	1	2									
24	13	14.1	12.8	1	3									
25	13	11.9	11.1	1	2									
26	13	13.7	11.5	1	4									
27	13	12.6	11.1	2	3									
28	13	13.9	11.8	2	3									
29	13	13.6	12.2	2	3									
30	13	15.2	12.3	2	4									
31	13	14	12.2	2	4									
32	13	14.4	12.2	2	4									
33	13	14.3	12	2	4									
34	13.5	12.6	11.6	2	2									
35	13.5	14.6	12.8	1	4									
36	13.5	15.2	14	1	1									
37	13.5	15.8	13.1	1	4									
38	13.5	16.2	13.5	2	3									
39	13.5	14.5	12.8	2	3									
40	13.5	14.8	13.6	2	2									
41	13.5	15.2	13.4	1	4									
42	13.5	15.1	13.7	2	2									
43	13.5	16.4	14.1	1	4									
44	14	15.7	13	1	4									
45	14	15.6	14.4	2	2									
Garuma kl.	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5
Skaitis	4	2	2	2	3	10	14	20	23	29	22	20	14	4
Svars	26.5	14.6	16.7	19.5	34.4	127.2	192.1	298.7	384.1	548.2	449	433.8	322.2	108.1
Garuma kl.	17.5	18	18.5	19	19.5	20	21							
Skaitis	4	4	2	2	1	1	1							
Svars	109.4	120.3	72.9	64.4	36.5	54.9	48.3							

Figure 5b. Fish biological analysis card with a filling example for pelagic fish (sprat and herring). At the bottom, you can see the mass measurement form.

For various fish species, the method of biological analysis differs. For example, for cod, biological information is collected by calculating so that an age-length key (with otoliths from at least 30 fish in each 5 cm length group) can be created for each fishing subarea from the data collected during the trip.

For flounder, during the trip at sea, analysis is performed on 25 randomly selected discarded fish. If flounder analysis is performed in the laboratory, it is preferable to analyse all the brought fish samples.

For herring and sprat, the biological sample consists of at least 200 fish. In the biological sample, fish are measured (length to the end of the tail) and sorted into length groups with a 0.5 cm interval. Then, the number of fish in each length group is counted and weighed. For herring, biological analysis is performed on up to 10 randomly selected fish from each length group.

For sprat, biological analysis is performed on up to 5 randomly selected fish from each length group up to 8.5 cm, up to 10 randomly selected fish from each 9.0 and 9.5 cm length group, and 15 randomly selected fish from each length group over 10.0 cm. Pelagic fish biological samples, if necessary, can be frozen and analysed later in the laboratory.

In standard biological analysis, the following information is collected for each fish:

- Maximum length, cm
- Total weight, g
- Gender
- Gonad maturation stage (according to a 7-point scale)
- Otoliths for age determination
- Scales for salmonid fish
- Notes

4.2. Length Measurements

The total length of the fish is measured from the snout to the furthest point of the tail in centimetres, rounding down the result. For example, all fish with a length from 20.0 to 20.9 cm are recorded as 20 cm. An exception is made for herring and sprat, which are measured with a precision of up to 0.5 cm.

4.3. Individual Mass

Fish caught at sea are weighed using electronic "Kern" scales or "Pesola" spring scales. Fish mass measurements at sea should be carried out under the best possible weather conditions. The total weight of the fish is recorded. In the laboratory, fish are weighed using electronic scales.

4.4. Gender

When performing biological analysis, the gender of the fish is noted, using the following code scheme:

Sex	Code
Male	1
Female	2
Unidentifiable	3
Juvenile	0

4.5. Stages of Sexual Maturity

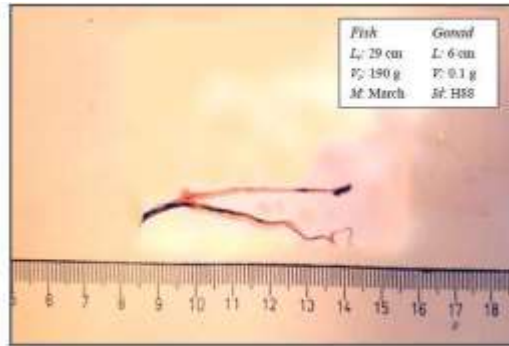
For the assessment of maturity stages, the universal 6-point scale is used. The number 7 is used to denote specific cases where deviations from the norm are observed (beginning of gonad degeneration processes or when the fish has lost its reproductive capabilities due to aging processes).

4.5.1. Cod

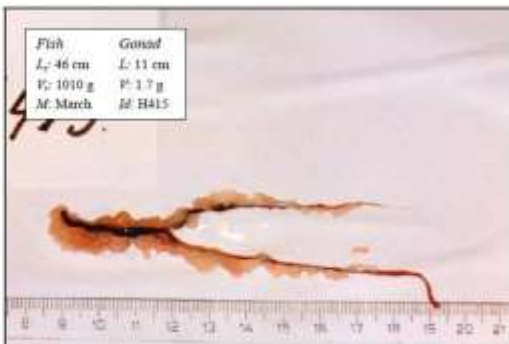
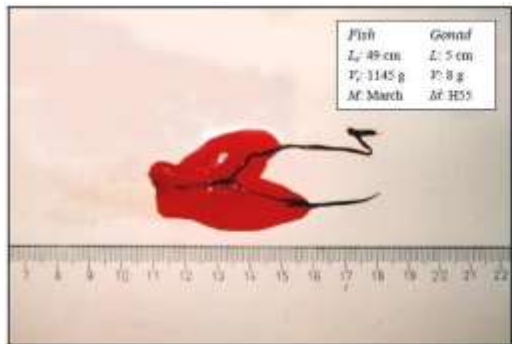
For cod, the maturity stages for females are shown on the left in the images, and for males on the right (6 stage scale).

Image source: "Manual to determine gonadal maturity of Baltic cod," J. Tomkiewicz, L. Tybjerg, N. Holm, A. Hansen, C. Broberg & E. Hansen. 2002. DFU report no. 116-02.

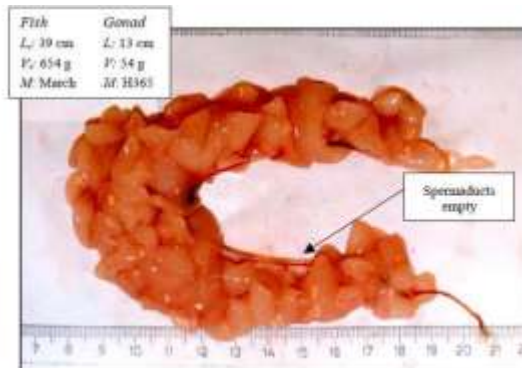
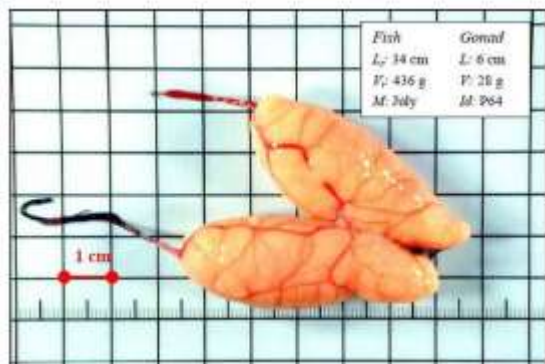
1. Maturity Stage (Juvenile): Prepubescent individuals - difficult to determine sex; they are slim and thread-like.



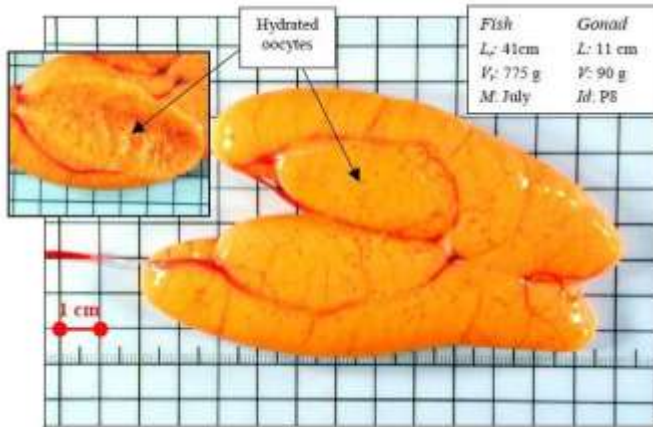
2. Maturity Stage: Maturing individuals or post-spawners. Gonads are semi-transparent. Individual oocytes are well visible under magnification. Female gonads consist only of oogonia or oogonia with young oocytes. In males, cells form spermogonia in the proliferation stage.



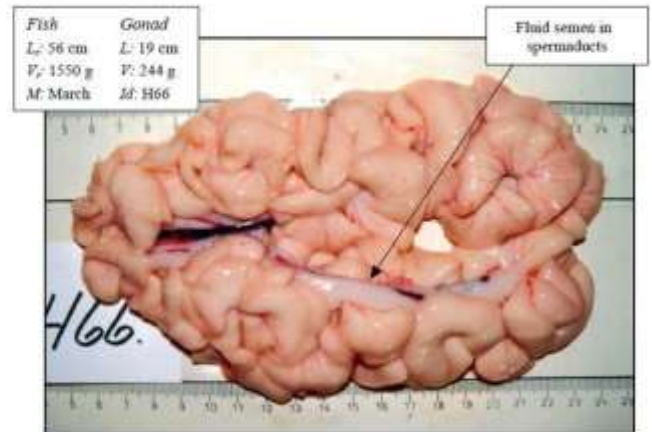
3. Maturity Stage: Oocytes are visible to the naked eye and are yellowish. Upon tearing, they form clusters consisting of several oocytes. Testes are enlarged; when cut perpendicular to the axis, the edges of the cut are not blurred.



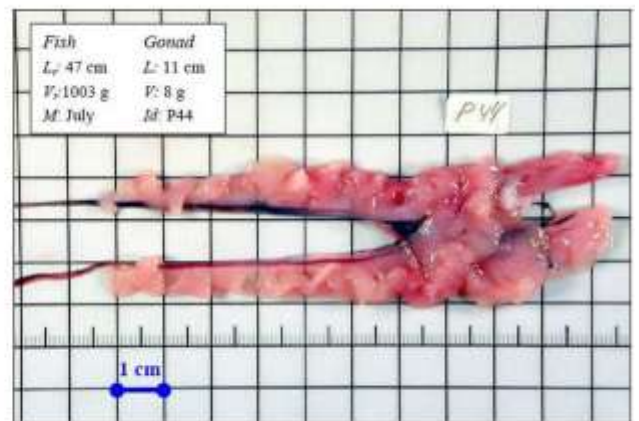
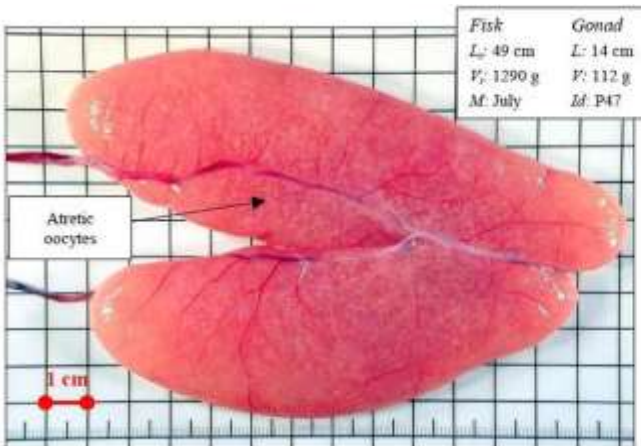
4. Pre-Spawning Stage: Large, separated oocytes. They easily separate when the gonad is cut. Oocytes that have completed their growth have a shell and a micropyle. The testicular ducts contain sperm that has been released from the cysts. When cut perpendicular to the axis, the edges of the cut of the testes become blurred.



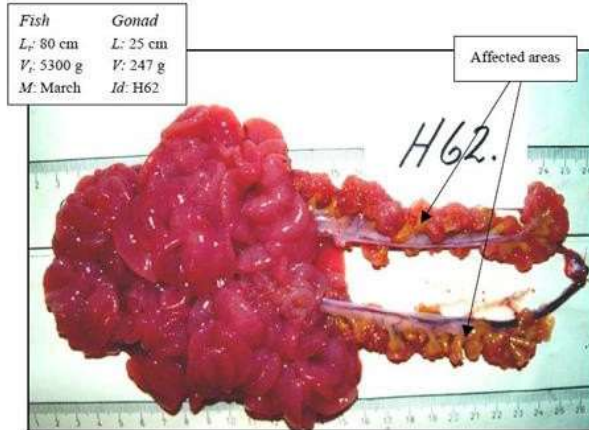
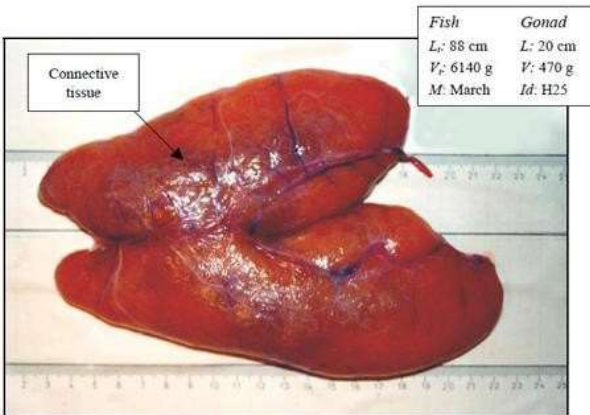
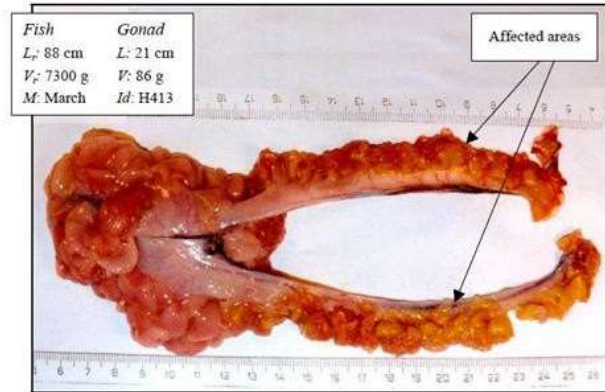
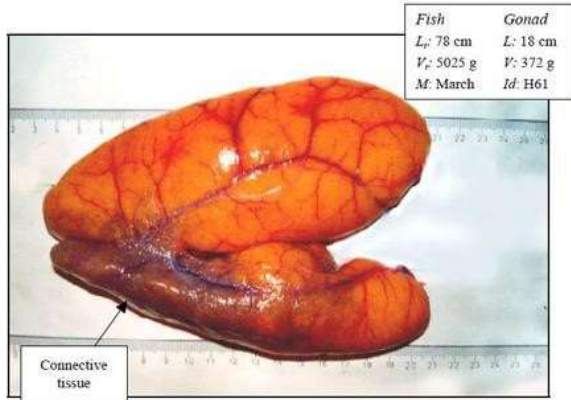
5. Spawning Stage: Spawning individuals - release of eggs and sperm.



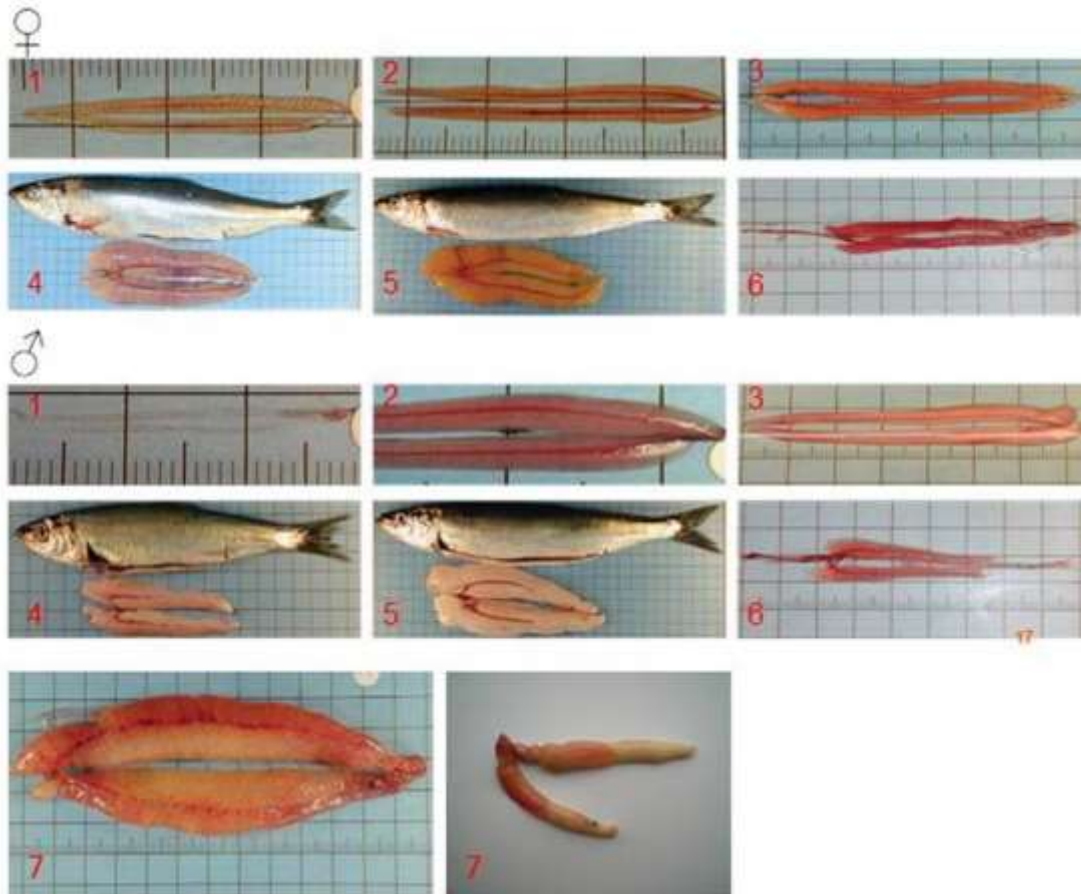
6. Post-Spawning Stage: Post-spawning individuals - gonads are small, ruptured, and appear damaged.



7. Degeneration: Reduced fertility. Formation of fibrous tissue in the ovaries: the affected areas are compact and hard, brownish-red, opaque; the unaffected parts develop normally. Observed in females from 65 cm. Formation of adipose tissue in the testes: the affected areas are undeveloped, hard, yellowish, while the unaffected parts develop normally. Observed in males from 50 cm.



4.5.2 Herring



Dzimumnobriešanas stadijas reņģei (Kiseļēviča skala – 6+1 stadijas, ♀ - mātīte, ♂ - tēviņš).

Images from:

https://www.aqua.dtu.dk/english//media/Institutter/Aqua/Publikationer/Forskningsrapporter_151_200/197_08_manual_to_determine_gonadal_maturity_of_herring.ashx?la=da&hash=63489CFEB01AC81352B7C070F8946FD145054936

1. Juvenile stage (sex products immature, gonads in males are transparent and thread-like, forming a lancet shape, gonads in females are yellowish and thicker than in males, surface ribbed);
2. Undeveloped sex products (stage before the first or subsequent maturation (after spawning));
3. Maturation stage (sex products begin to develop - individual oocytes are visible in females, testes in males turn white, but sex products do not occupy the entire body cavity);
4. Maturation stage (well-developed sex products occupy most of the body cavity);
5. Spawning stage (sex products occupy the entire body cavity or, in the case of incomplete body cavity occupation, if spawning is in progress, pressing on sex products causes them to flow easily);
6. Post-spawning stage (gonads stretched, often bloody, a small amount of sex products may remain inside. This stage gradually transitions to stage 2);
7. Abnormal stage (various developmental abnormalities - resorption, both sexes in one individual, one gonad undeveloped, etc.).

4.5.3 – Sprat

The stages of sexual maturation for flounder (*Kisielēviča* scale - 6+1 stages). Flounders have a portioned type of spawning - three sub-stages are distinguished for stage 6.

Stage nr.	Title	Gonad description	
I	Juvenile stage	The gonads are small, elongated, thread-like, pale, and transparent. The gender cannot be determined without a microscope	
		Females	Males
III	The gonads are immature.	The ovaries are small, elongated, thin, pale yellow, transparent, or partially transparent. Oocytes are not visible to the naked eye; they are transparent, glass-like, and can be observed under a microscope, with a diameter of ≤ 0.2 mm.	The testes are very thin, semi-transparent, grayish, ribbon-shaped, and located along undeveloped blood vessels.
IV	Stage of maturation.	The ovaries enlarge and at the end of the stage occupy up to 2/3 of the body cavity. At the beginning of the stage, they are transparent, and at the end, they become yellowish. Oocytes are visible through the ovarian membrane, with a diameter of 0.2-0.3 mm at the beginning of the stage and 0.5 mm at the end. The oocytes are attached to each other and cannot be easily separated.	The testes enlarge and at the end of the stage occupy the majority of the body cavity. They are firm, initially grayish-white, and become white by the end of the stage. When cut, the cut surface retains its shape.
V	Stage of maturation.	The ovaries occupy the entire free space in the body cavity; they are not transparent and usually have a distinct yellow color. The oocytes have a diameter of 0.5-0.6 mm. The oocytes can be easily separated from each other.	The testes occupy the majority of the body cavity. They are firm and white. If cut, the cut surface changes its shape, squeezing out a small amount of sperm.
VI	Spawning stage	The ovaries have swollen, become watery, and the oocytes have separated from each other. When lightly pressed on the abdomen of the female, they are released outside through the genital opening.	Sperm easily escapes from the genital opening.
VI: VI-II	Post-spawning stage	The ovaries are small, bloody, usually without oocytes. The gonads later return to the II stage.	The testes are small and bloody, firm, and opaque. They do not contain sperm and later return to the II stage.
VI-III	Stage of maturation of portions.	The next portion is developing. Ovaries and oocytes are similar to Stage III, but in a reddish color.	The next portion is developing. Testes are similar to Stage III, but they are smaller and reddish in color.
VI-IV	Stage of maturation of portions.	The next portion is developing. Ovaries and oocytes are similar to Stage VI, but they are reddish in color.	The next portion is developing. Testes are similar to Stage VI, but they are smaller and reddish in color.

VIII	Abnormal stage	Various developmental abnormalities can occur, such as resorption, hermaphroditism, underdeveloped gonads, and others.
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4.6. Collection and Storage of Otoliths

For each fish, two otoliths (sagitta) are extracted and placed in a special paper booklet. If the observer is working alone at sea, for example, in a cod commercial fishing trip, each page of the booklet is marked with the fish's order number, and biological information is indicated (length, weight, gender, and gonadal maturity stage). Later, this information from the booklet is transferred to the biological analysis cards. If biological analysis is done in a laboratory, the information about the fish is immediately recorded on the biological analysis cards, and only the otoliths are wrapped in the booklet. Only the fish's order number is written on the pages of the booklet. Otoliths are collected in booklets (Figure 6 and 7). Each booklet includes:

- Fishing date
- Trip number
- Fishing gear
- Fishing act number
- Vessel
- Fishing subregion
- Fish species
- Catch fraction.
- Individual fish numbers in the booklet (from - to).
- Please note that specific numbers and details may vary based on the actual documents and procedures used in the fishing industry.

25.06.2018
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MENCA BMS
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Figure 6. Example of the first page of logbooks.

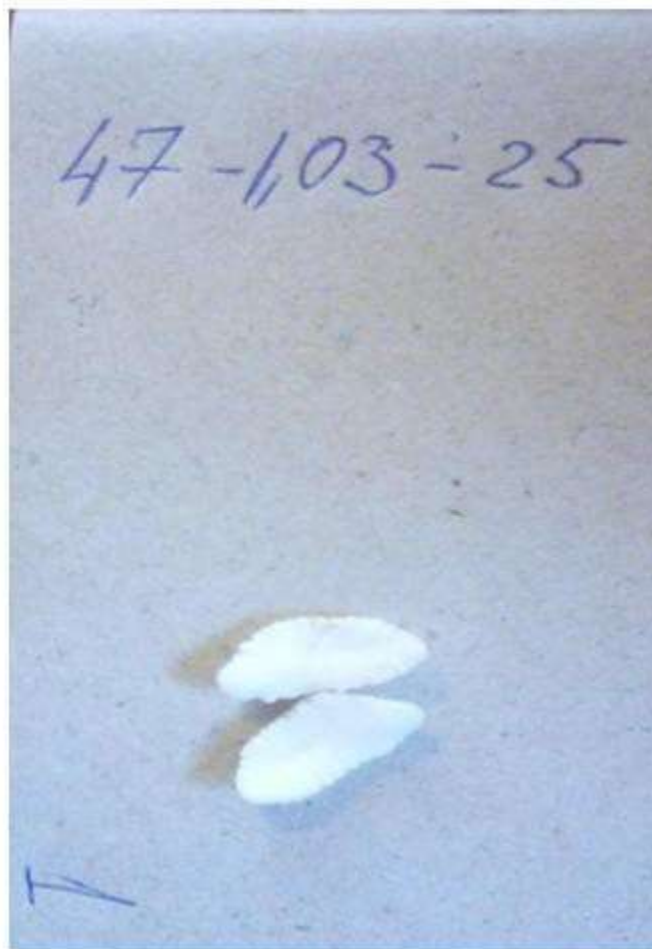


Figure 7. An example of filled logbook pages with inserted cod otoliths and biological information about the first analyzed fish (ID 1).

4.6.1

Cod

For cod, otoliths are taken using scissors. The fish's head is held by inserting the thumb and index finger simultaneously into the fish's eye. Another option is to insert the thumb into the fish's throat. The scissors are positioned approximately 1 centimeter above the eyes and make a sharp cut at a 30-degree angle, then make a sharp break in the head relative to the body (Figure 8). In the case of an ideal cut, the upper part of the skull and the brain beneath it are exposed. Otoliths are located in a ridged mass longitudinally, with the curved surface facing inwards (Figure 9). Otoliths are removed with tweezers, cleaned of tissue remnants (Figure 10), and wrapped in a paper booklet on the respective logbook page that matches the fish's individual order number in biological analysis (Figure 7).

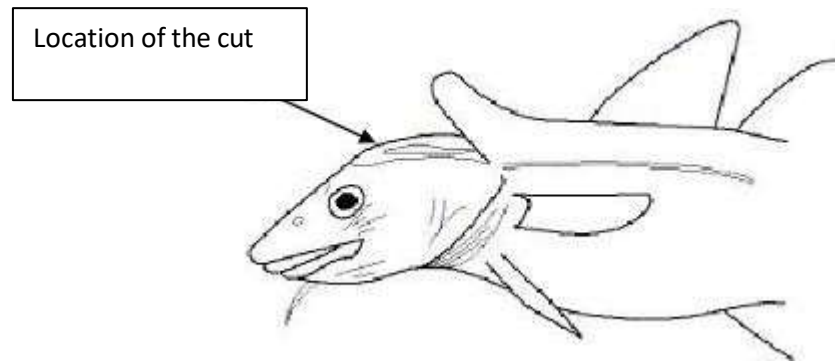


Figure 8. The cutting scheme for removing cod otoliths.

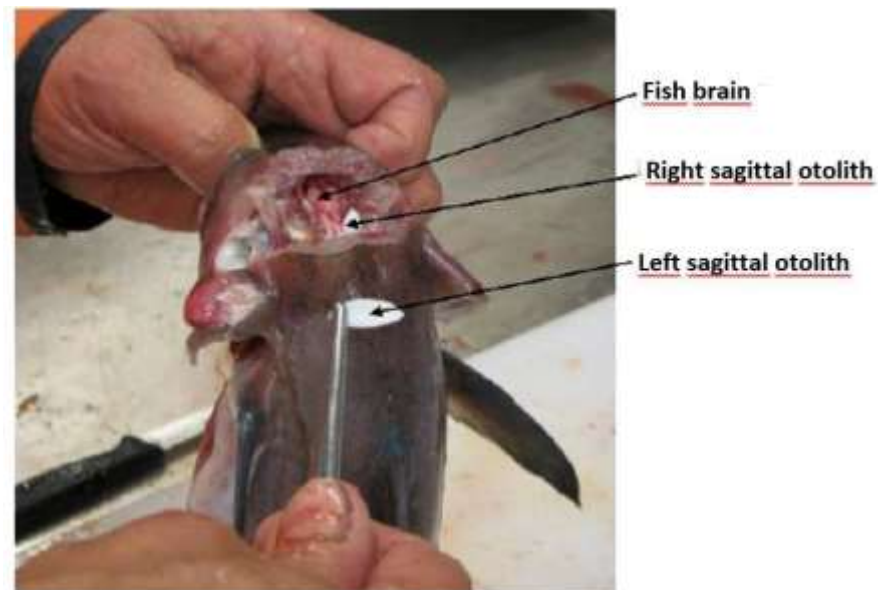


Figure 9. The removal of otoliths from a cod head.



Figure 10. Cod otoliths

4.7. Scale Sampling Locations for Salmonid Fish

The location for taking salmon scale samples is indicated by a red rectangle (Figure 11). Before taking each new scale sample, the knife must be wiped clean with a paper towel to prevent possible mixing of scales between different fish. The scales are wrapped in a paper booklet. The principle of organizing scale booklets is the same as collecting fish otoliths.

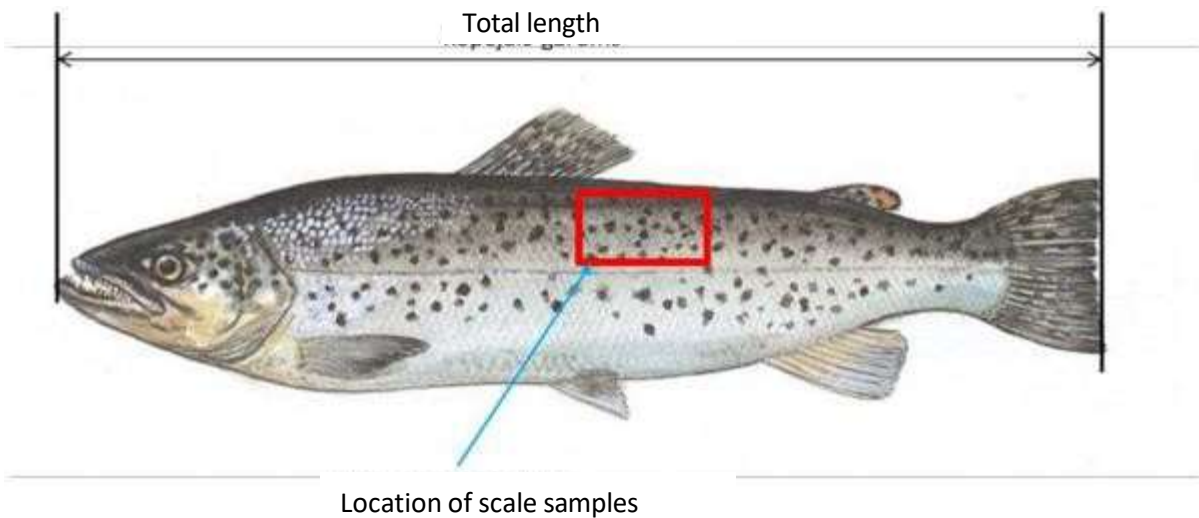


Figure 11. Schematic for taking salmonid fish scales.

5. Fish Length Measurements

Length measurements are taken for randomly selected, unsorted fish, separately for each catch fraction. The measured fish's maximum length in centimetres is recorded. Mass measurements are conducted based on the catch size and the specific situation. The measured portion of the sample should be indicated in kilograms.

The total length of the fish is measured in centimetres from the snout to the farthest point on the tail, rounding the result down to the nearest whole number. For example, all fish with a length between 20.0 and 20.9 cm are recorded as 20 cm. An exception is made for sprat and herring, which are measured with precision up to 0.5 cm or 0.1 cm. The results of fish length measurements are recorded on special cards (Figures 13 and 14). The information on these cards is duplicated with the corresponding information from the catch cards.

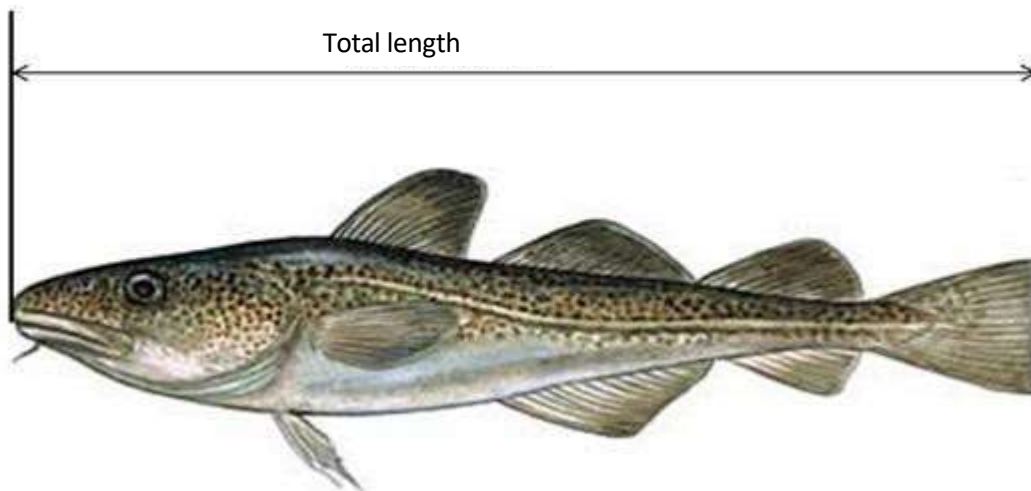


Figure 12. Cod length measuring

Zivju masu mērijuma kartiņa																Lapušu skaits <input type="text" value="1"/> Lapas nr. <input type="text" value="1"/>			
Zivju suga		COD		Datums		28.05.2014		Parauga veids:											
Reisa No		1001		Kuģa No		0831		<input checked="" type="checkbox"/> Rūpnieciskā zveja jūrā		<input type="checkbox"/> Pētnieciskā zveja		<input type="checkbox"/> BMS							
Zvejas akta No		1		Zvejas rīks		GNS		<input type="checkbox"/> Osta		<input type="checkbox"/> Bez atlasēs									
Apakšrajons		26		Acs izmērs, mm		110		<input checked="" type="checkbox"/> Izmetums		<input type="checkbox"/> Ar atlasi									
Zona				Zvejas ilgums		800		Parauga svars, kg		5									
LV kvadrāts		501		Zvejas ilgums				Izmēra kategorija		0									
Loms, kg		5																	
No.	Garums, cm	Dzīms	Stads	No.	Garums, cm	Dzīms	Stads	No.	Garums, cm	Dzīms	Stads	No.	Garums, cm	Dzīms	Stads	No.	Garums, cm	Dzīms	Stads
1	5 3			51				101				151				201			
2	3 9			52				102				152				202			
3	4 4			53				103				153				203			
4	6 6			54				104				154				204			
5	3 9			55				105				155				205			
6	4 1			56				106				156				206			
7				57				107				157				207			
8				58				108				158				208			
9				59				109				159				209			
10				60				110				160				210			
11				61				111				161				211			
12				62				112				162				212			
13				63				113				163				213			
14				64				114				164				214			
15				65				115				165				215			
16				66				116				166				216			
17				67				117				167				217			
18				68				118				168				218			
19				69				119				169				219			
20				70				120				170				220			
21				71				121				171				221			
22				72				122				172				222			
23				73				123				173				223			
24				74				124				174				224			
25				75				125				175				225			
26				76				126				176				226			
27				77				127				177				227			
28				78				128				178				228			
29				79				129				179				229			
30				80				130				180				230			
31				81				131				181				231			
32				82				132				182				232			
33				83				133				183				233			
34				84				134				184				234			
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41				91				141				191				241			
42				92				142				192				242			
43				93				143				193				243			
44				94				144				194				244			
45				95				145				195				245			
46				96				146				196				246			
47				97				147				197				247			
48				98				148				198				248			
49				99				149				199				249			
50				100				150				200				250			

Figure 13. Fish weight measurement card with example entries

Zivju masu mērijuma kartiņa

Lapuņu skaits Lapas nr.

Zivju suga	COD	Datums	2018-06-26
Reisa No	1006	Kuģa No	2125
Zvejas akta No	7	Zvejas rīka	OTB
Apakšrajons	26	Acs izmērs, mm	120
Zona		Zvejas ilgums	540
LV kvadrāts	794	minūtēs	
Loms, kg	27		

Parauga veids:

Rūpnieciskā zveja jūrā
 Pārticiskā zveja
 Osta Bez atlasēs
 Izmēlums Ar atlasi
 BMS

Parauga svars, kg	27
Izmēra kategorija	

Cm	Skaitis	Cm	Skaitis
14		64	
15		65	
16		66	
17		67	
18		68	
19		69	
20		70	
21		71	
22		72	
23		73	
24		74	
25	1	75	
26		76	
27		77	
28		78	
29	3	79	
30	5	80	
31	10	81	
32	10	82	
33	13	83	
34	11	84	
35	31	85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	
51		101	
52		102	
53		103	
54		104	
55		105	
56		106	
57		107	
58		108	
59		109	
60		110	
61		111	
62		112	
63		113	

Figure 14. Fish weight measurement card with example entries

6. Calculation of Sample Mass

The total mass of the analyzed samples (W) from weight measurements for the respective fishing subarea can be calculated using the formula:

$$W = W_i \times N_i$$

where:

W_i represents the average weight in length group i .

N_i represents the number of measured fish in length group i .

For the purposes of biological analysis, the total mass of the sample can be determined by summing the individual masses of all the analysed fish.

7. Calculation of Total Species-Specific Fish Counts

The total number of fish in the catch can be calculated in various ways:

- One of the methods is to use the ratio between the total mass of the catch and the mass of the unsorted sample (biological analysis + weight measurements). This ratio provides a coefficient, which, when multiplied by the number of fish in the unsorted sample, gives the total number of fish in the catch. For example:

$$\frac{\text{catch weight}}{\text{sample weight}} = \frac{220}{54} \times 182 \text{ (66 fish in the unsorted sample} \\ \text{/ 116 fish in the biological analysis)} = 741 \text{ fish}$$

If fish are weighed in boxes with a specific mass, the total number of fish on board can be determined using the number of boxes weighed. For example:

$$\frac{\text{total number of boxes}}{\text{measured number of boxes}} = \frac{132}{1} \times 32 = 4224 \text{ fish}$$

If there is a discard or a Biological Minimum Size (BMS) in the catch, a separate sample is taken from it, which is used to calculate the fish count in the respective category. The desired sample size is 25-50 kg. If the discard is not large, all fish are measured.

8. Incidental Bycatch of Birds, Mammals, or Protected Fish Species

In the case of accidental bycatch of rare fish species, it is advisable not only to weigh and measure them but also to photograph them. If possible, you should freeze them and bring them to the institute's laboratory.

In every fishing trip where seals are observed, their count should be recorded. If there are any seal-inflicted damage to the gear (for example, only fish heads left in the nets), these should also be documented, indicating which fish species were damaged and their approximate quantity/weight.

In the case of accidental bycatch of marine mammals or birds, it is necessary to note whether the caught object was alive or already dead, and what happened to it afterward - released, discarded at sea, or something else. If possible, marine mammals or birds should be measured, weighed, and photographed.

For ringed birds, you should report them to the Latvian Ringing Centre via email at ring@latnet.lv or by phone at 67945393 or 29491927. The report should include the following information: all the information found on the ring, the nearest populated location (coordinates of the fishing site), the date when the ring was obtained, the circumstances in which the ring was obtained, the observer's address so that ringing data can be provided to you.

9. Trip Reports

After each fishing trip, it is necessary to fill out a trip report (see Figure 15). One copy of the report is retained by the observer who conducted the respective trip, and the other copy is given to the head of the institute's Information and Data Department.

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Ani1llriz@t.o, zivju skaits ar otolib@m (pa sug,am) gah.	oildus 2iivs g1arrumaim ir atzimets dzim1.1ms)					
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	Memca,		326			
	Pr.ekste		25			
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Figure 15. Trip report with a filled out example (in Latvian).