WORKING GROUP ON SURVEYS ON ICHTHYOPLANKTON IN THE NORTH SEA AND ADJACENT SEAS (WGSINS; outputs from 2023 meeting)

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i Executive summary

The Working Group on Surveys on Ichthyoplankton in the North Sea and adjacent Seas (WGSINS) coordinates surveys on fish early life stages undertaken for assessment and management purposes. The objectives of WGSINS include review and coordination of these surveys, quality assurance on survey methodology, species identification, provided data and indices, preparation of data for archival, as well as identification of additional objectives that can be achieved by the surveys.

WGSINS coordinates seven surveys, three in the North Sea (IHLS - International herring larvae surveys in the North Sea, MIK - North Sea Midwater Ring Net survey, DRS - Downs recruitment survey), two in the Irish Sea (NINEL - Northern Irish Northeastern Larvae Survey, NI-MIK - Northern Ireland MIK Survey) and two in the Baltic (RHLS - Rügen herring larvae survey, BIS - Baltic Ichthyoplankton Surveys). Most surveys target herring larvae from various stocks, while the NI-MIK targets pelagic juvenile gadoids and the BIS eggs and larvae of Eastern Baltic cod.

At WGSINS 2023, cruise summaries and results from the seven surveys were presented. All relevant estimates and indices from the surveys were updated, and data were uploaded into the ICES eggs and larvae database. New methodologies to incorporate the DRS into the MIK recruitment index time-series were discussed and evaluated, concluding that these can provide improvements to the existing MIK index. However, further refinement is needed before these are presented to the Herring Assessment Working Group (HAWG).

The chair of WGSMART presented updates on the egg and larvae module in SmartDots. WGSINS agreed to provide expertise and support in reviewing documentation and testing of further software developments. Representatives from the ICES Data Centre presented updates to the ICES eggs and larvae database, and introduced the new Fecundity and Atresia Database. A newly established governance group for these two databases, the Working Group for Egg & Larvae and Fecundity & Atresia Database Governance (WGELFADG), was introduced.

WGSINS provides a forum to present and discuss additional work conducted on ichthyoplankton surveys that can provide additional information and data products, such as investigations on non-target ichthyoplankton species, other organisms like jellyfish and zooplankton, or marine litter. Several presentations highlighted the potential of ichthyoplankton surveys to provide added value, improving our understanding of pelagic ecosystems and contributing to stock assessment and management. A pilot study on sandeel larvae identified for example spawning areas in the North Sea which contributed to the re-evaluation of management areas during the recent benchmark workshop on sandeel, while another pilot survey aimed to establish a recruitment index for North Sea sprat. Ideas for other additional sampling opportunities were presented and discussed, such as sampling of cephalopod early life stages to identify spawning and nursery areas.

WGSINS will continue to collect and archive additional information, underrepresented in traditional fishery survey datasets, aiming to contribute to the implementation of an ecosystem approach to fisheries management.

ii Expert group information

Expert group name	Working Group on Surveys on Ichthyoplankton in the North Sea and adjacent Seas (WGSINS)
Expert group cycle	Multiannual
Year cycle started	2022
Reporting year in cycle	2/3
Chair	Bastian Huwer, Denmark
Meeting venue(s) and dates	29 November - 01 December 2022, Belfast, Northern Ireland (13 participants)
	28 November - 01 December 2023, Aberdeen, Scotland (12 participants)

1 Survey results

1.1 The International Herring Larvae Surveys in the North Sea (IHLS)

1.1.1 The IHLS in 2022/2023

Five survey areas were covered within the framework of the International Herring Larval Surveys in the North Sea during the sampling period 2022–2023. They monitored the abundance and distribution of newly hatched herring larvae in the Orkney/Shetlands area, in the Buchan area and the central North Sea (CNS) in September and in the southern North Sea (SNS) in December 2022 and January 2023 (Figure 1.1, Figure 1.2, Figure 1.3). While four survey were conducted as scheduled, the survey in the English Channel in January 2023 struggled with technical problems of the vessel and unfavourable weather condition. Thus, only 50% of the planned stations have been sampled in January 2023.

The survey around the Orkneys revealed lower quantities of newly hatched larvae, and their distribution was different from previous years. Most larvae were not found close to the Orkneys, but much more easterly than usual, on the outer edge of the survey area. These larvae may have drifted here down from the Shetlands, but the actual reason is unknown.

In the Buchan and the central North Sea, newly larvae hatched in two areas, while the remaining stations contributed only very low numbers of larvae (Figure 1.1).

The distribution of larvae on the southern North Sea in the December survey was unusual in that manner that highest concentration of larvae were observed in the inner part of the English Channel (around Sandettie Bank), and not at the most westerly stations as in other years. Higher abundance of larvae around Sandettie Bank were also observed during the survey in January, but due to heavy wind speeds and high waves, the western parts of the area were out of reach and could not be sampled.

No survey was planned for the second half of January 2023. Instead, an additional MIK sampling is scheduled for April 2023 in the German Bight and Skagerrak/Kattegat area. This sampling should shade light on the foraging and recruitment of herring larvae originating in the Downs stock component. This survey is described in section 1.3.

The Larvae Abundance Index (LAI, Tab 1.1.1) is used as input data into the North Sea autumn spawners assessment model. Spatial stock dynamics are resolved inside the model.

In 2022, in almost all observed area in the North Sea, newly hatched herring larvae at the spawning grounds were less abundant compared to recent years. It is necessary to underpin and verify these findings in the upcoming sampling period.

At time of the 2023 WGSINS meeting, the 2023/2024 sampling period is still in progress. The surveys in September were conducted as scheduled. Plankton sorting and larvae length measurements are ongoing. First results on larvae abundance and distribution in the Orkney/Shetland area are shown in Figure 1.4. The distribution is in line with years prior to 2022, but the number of caught larvae is again low.

Table 1.1 Herring Larvae Abundance Time-Series (LAI) of larvae <10 mm long (<11 mm for the SNS), by standard sampling area and time periods. The numbers of larvae are expressed as mean numbers per ICES rectangle * 10^9

	Orkney/ Shetland		**Buchan**		**Central North Sea**			**Southern North Sea**		
Period/ Year	1-15 Sep.	16-30 Sep.	1-15 Sep.	16-30 Sep.	1-15 Sep.	16-30 Sep.	1-15 Oct.	16-31 Dec.	1-15 Jan.	16-31 Jan.
1973	2029	822	3	4	492	830	1213			1
1974	758	421	101	284	81		1184		10	
1975	371	50	312			90	77	1	2	
1976	545	81		1	64	108			3	
1977	1133	221	124	32	520	262	89	1		
1978	3047	50		162	1406	81	269	33	3	
1979	2882	2362	197	10	662	131	507		111	89
1980	3534	720	21	1	317	188	9	247	129	40
1981	3667	277	3	12	903	235	119	1456		70
1982	2353	1116	340	257	86	64	1077	710	275	54
1983	2579	812	3647	768	1459	281	63	71	243	58
1984	1795	1912	2327	1853	688	2404	824	523	185	39
1985	5632	3432	2521	1812	130	13039	1794	1851	407	38
1986	3529	1842	3278	341	1611	6112	188	780	123	18
1987	7409	1848	2551	670	799	4927	1992	934	297	146
1988	7538	8832	6812	5248	5533	3808	1960	1679	162	112
1989	11477	5725	5879	692	1442	5010	2364	1514	2120	512
1990		10144	4590	2045	19955	1239	975	2552	1204	
1991	1021	2397		2032	4823	2110	1249	4400	873	
1992	189	4917		822	10	165	163	176	1616	
1993		66		174		685	85	1358	1103	
1994	26	1179				1464	44	537	595	
1995		8688					43	74	230	164
1996		809		184		564		337	675	691
1997		3611		23				9374	918	355

	Orkney/ Shetland		Buchan		Central North Sea			Southern North Sea		
1998		8528		1490	205	66		1522	953	170
1999		4064		185		134	181	804	1260	344
2000		3352	28	83		376		7346	338	106
2001		11918		164		1604		971	5531	909
2002		6669		1038			3291	2008	260	925
2003		3199		2263		12018	3277	12048	3109	1116
2004		7055		3884		5545		7055	2052	4175
2005		3380		1364		5614		498	3999	4822
2006	6311	2312		280		2259		10858	2700	2106
2007		1753		1304		291		4443	2439	3854
2008	4978	6875		533		11201		8426	2317	4008
2009		7543		4629		4219		15295	14712	1689
2010		2362		1493		2317		7493	13230	8073
2011		3831		2839		17766		5461	6160	1215
2012		19552		5856		517		22768	11103	3285
2013		21282		8618		7354		5	9314	2957
2014		6604		5033		1149				1851
2015		9631		3496		3424		2011	1200	645
2016				3872		3288		20710	1442	1545
2017				5833		3965		10553	5880	
2018		102		1740		1509		1140		
2019	2488		5654	3794		10605		14082	5258	
2020		3208		3418		7663		4077	9704	
2021		6651		1413		3282		8899	8764	
2022		2758		1471		188		3712	743	

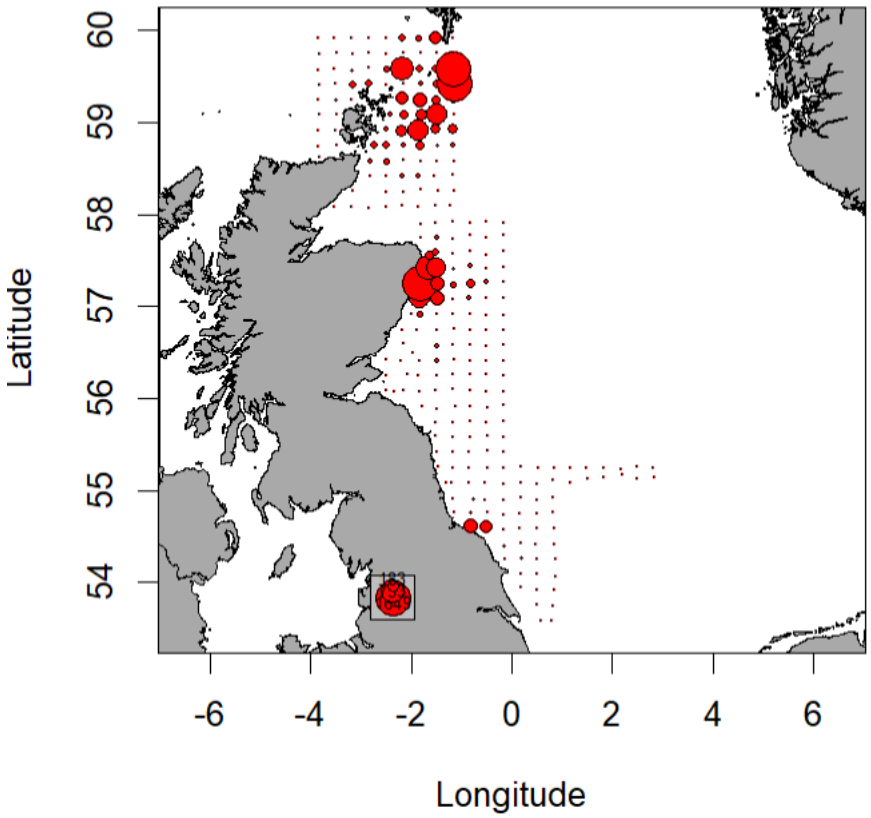

Figure 1.1 North Sea herring - Abundance of larvae < 10 mm (n/m²) in the Orkney/Shetlands, the Buchan and the central North Sea area, second half of September 2022 (maximum circle size = 1 650 n/m²).

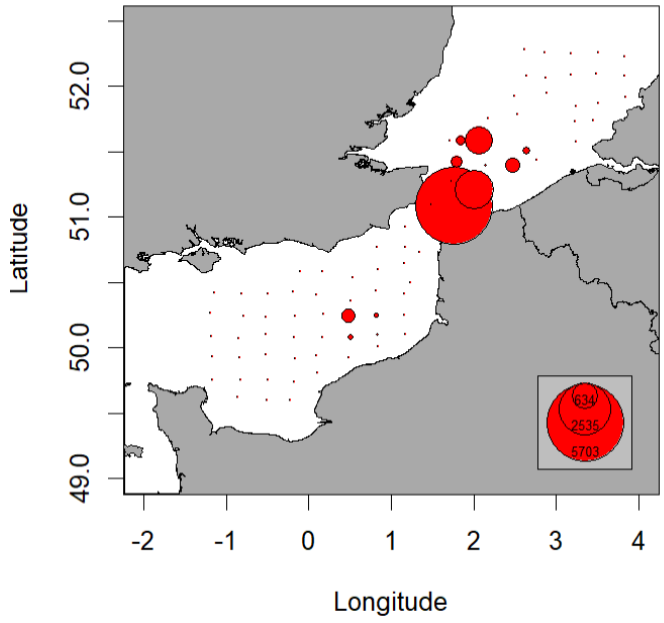

Figure 1.2 North Sea herring - Abundance of larvae <11 mm (n/m²) in the Southern North Sea and English Channel, second half of December 2022 (maximum circle size = 5 700 n/m²).

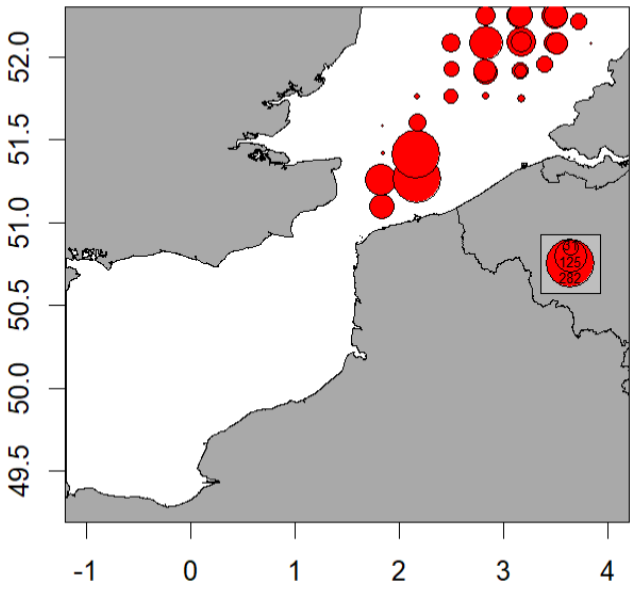

Figure 1.3 North Sea herring - Abundance of larvae <11 mm (n/m²) in the Southern North Sea and English Channel, first half of January 2023 (maximum circle size = 280 n/m²).

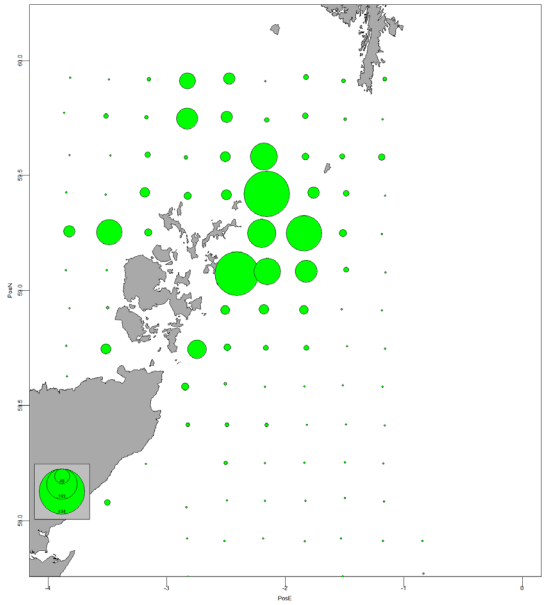

Figure 1.4 North Sea herring - Abundance of larvae (all sizes, n/m²) in the Orkney/Shetlands area, second half of September 2023 (maximum circle size = 500 n/m²).

1.1.2 Planning of the 2024 IHLS surveys

The IHLS surveys give information about herring larvae hatching success and larvae abundance on the main spawning grounds of North Sea autumn spawning herring. They also inform about the relative contribution of the different spawning components to the whole stock. In general, on four different spawning areas, two (Orkney/Shetlands and Buchan) or three (Banks and Downs) sampling periods are needed monitoring the full spawning activity. This condition hasn't been

met since the mid of the 1990s, when several participants left the larvae surveys and continued with acoustic surveys thereafter. Nowadays, only the Netherlands and Germany participate in the IHLS and it is only possible to cover some sets out of the 10.

Instead of the survey in the southern North Sea in the 2nd half of January, an additional MIK-Survey, following foraging Downs herring larvae, was introduced and conducted since 2018. This additional survey sheds lights on the recruitment in the Downs stock component and is also scheduled to take place in spring 2024 (see Section 1.3 below).

The plan of the upcoming sampling period is given below.

Table 1.2 Areas and periods to be covered during the 2024 IHLS surveys

Area / Period	01.-15.09.	16.-30.09.	01.-15.10.
Orkney/Shetlands	None	FRG	
Buchan	None	NL	
Central	None	NL	None
Area/Period	16.-31.12.	01.-15.01.	16.-31.01.
Southern North Sea	NL	FRG	None

1.2 The North Sea Midwater Ring Net survey (MIK)

1.2.1 Background information

During the International Bottom Trawl Survey in the North Sea in the first quarter of the year (Q1 IBTS), night-time catches are conducted with the MIK net, a fine meshed (1600 μm) 2-m-midwater ring net (ICES 2017) providing abundance estimates for large herring larvae (0-ringers) of the autumn spawning stock components. The total abundance of 0-ringers in the survey area provides the 0-ringer index (also called MIK index), which is used as a recruitment index for the North Sea herring stock.

In addition, the Q1 IBTS also provides a time series of juvenile herring abundance in the North Sea (1-ringer index) which is based on the GOV bottom trawl catches carried out during daytime.

The time series of 0-ringer and 1-ringer indices from the Q1 IBTS survey exist since the 1977 year-class. It has to be borne in mind that the 0-ringer index reflects recruitment in the autumn spawning components, while the 1-ringer index includes both autumn spawning and other components. For more details on these two times series and their utilization in stock assessment, the reader is referred to the reports of the Herring Assessment Working Group (HAWG).

NOTE: There is presently an ongoing effort to establish a combined recruitment index for both the autumn spawning components and the winter spawning component (i.e. the Downs component), based on the Q1 MIK survey and the Downs recruitment survey (DRS). Further details on this can be found in the report section on the DRS (see section 1.3.2).

1.2.2 The MIK survey in 2023

The previous MIK-IBTS survey in 2022 had been faced with numerous challenges which resulted in poor sampling coverage (see previous WGSINS report for details). The 2023 survey was again faced with several challenges, but fortunately considerably fewer than in 2022. Due to technical issues with the steering gear and the trawl winches on RV Walther Herwig III, Germany lost approximately 1.5 weeks of survey time. Scotland also had technical problems with the engine as well as a Covid-19 infection onboard of RV Scotia, resulting in a loss of approximately 1 week of survey time. In addition, several participants had issues with severe weather conditions during parts of the survey period.

A total of 586 MIK hauls were conducted in 2023 (Table 1.3, Figure 1.5), which is 153 more than in 2022 but 97 less than in 2021. For the 2023 MIK 0-ringer index (corresponding to the 2022 year-class), all hauls north of 51° N were used, in total 569 hauls (for comparison: 2022 = 410 hauls and 2021 = 663 hauls).

A total of 716 MIK hauls were planned according to the 2023 NSIBTS Q1 program (the target is 4 hauls per ICES rectangle) and 586 were conducted, i.e. 82% of the planned MIK-stations were sampled in 2023 (Table 1.3). However, there has been a general increase in the number of MIK hauls throughout the time-series, and the 586 MIK hauls achieved in 2023 are above the long-term average of 505 hauls (time-series since 1992). Besides, thanks to coordination between participants during the survey, almost all ICES squares in the survey area were covered. Furthermore, the main distribution area of the herring larvae in the central and southern North Sea was well covered with at least 3 and mostly 4 MIK hauls per ICES square. Thus, the "missing" hauls in relation to the number of planned hauls and the resulting lower coverage with only 1 or 2 hauls per ICES square did mainly occur in the northern part of the survey area, which usually only yields relatively few herring larvae. Overall, the coverage achieved during the 2023 MIK survey was good and can be regarded to provide a representative 0-ringer index.

Table 1.3 Summary table of the MIK stations sampled during the North Sea Q1 IBTS in 2023

COUNTRY	MIK HAULS PLANNED	MIK HAULS CONDUCTED	% MIK CONDUCTED
Denmark	88	90	102
France	108	105	97
Germany	134	80	60
Netherlands	112	112	100
Norway	90	74	82
Scotland	116	78	67
Sweden	68	47	69
TOTAL	716	586	82

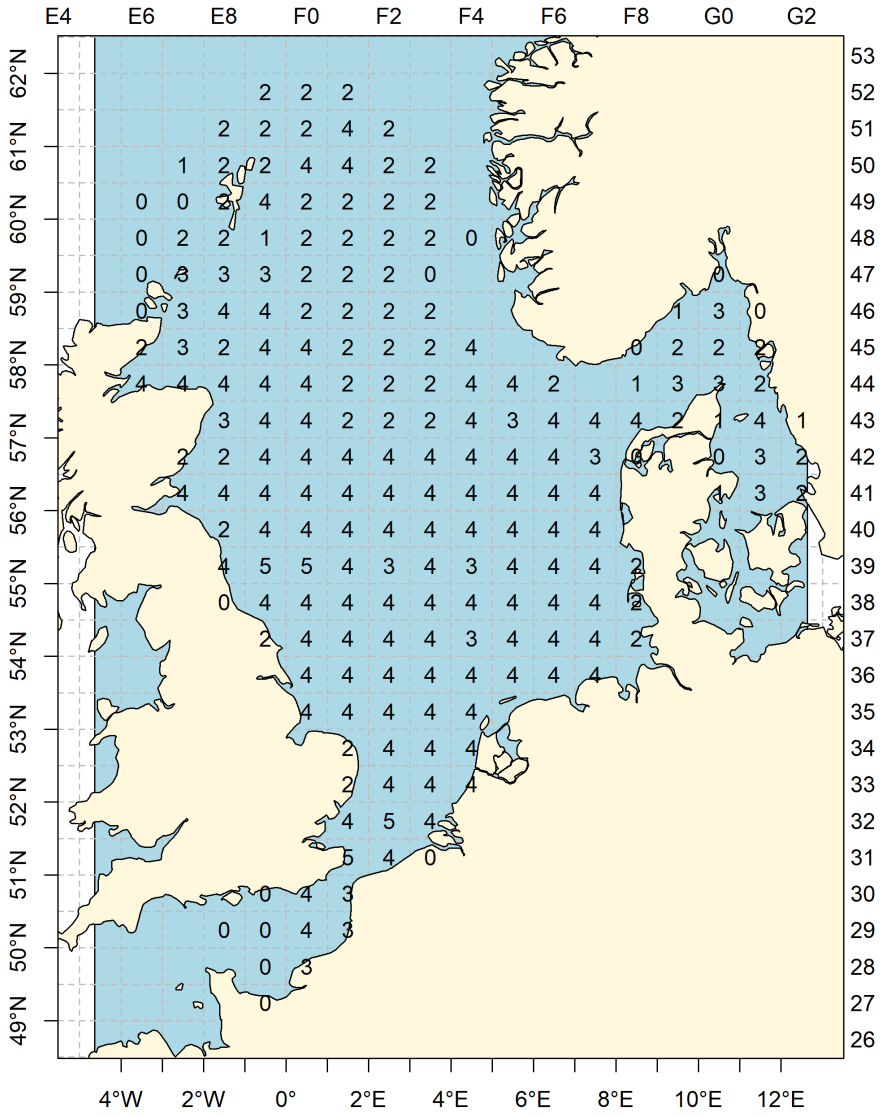

Figure 1.5 MIK sampling during IBTS Q1 2023 – numbers of MIK samples per each ICES rectangle.

1.2.3 Herring larvae distribution and abundance

Figure 1.6 shows the size distribution of MIK larvae in 2023. Herring larvae measured between 6 and 40 mm standard length (SL). Again, and as in most years, the smallest larvae <12 mm were numerous, with a peak at 10 mm. However, while these small larvae <12 mm often accounted for around 50 to 60% of the total number of larvae in other years, they only made up 33% of the total number of larvae in 2023. Instead, larvae in the size range between 13 and 17 mm were also numerous in the 2023 survey, with another peak at 15 mm. This interesting feature in the 2023 length distribution is similar to the length distribution in 2022, which also showed a peak at 15 mm. Larger larvae >18 mm SL were rarer, but their relative share was 20% and thus higher than in the two previous years 2022 and 2021, where the share of these larger larvae >18 mm was only 11 and 12%, respectively.

Figure 1.7 illustrates the spatial distribution of 0-ringers (>18 mm) in 2021, 2022 and 2023. As in previous years, the smallest larvae in 2023 were again chiefly caught in 7.d and in the Southern Bight. The 2023 distribution is partly similar to 2021, with higher abundances east of Scotland and along the UK coast. However, in the southeastern and eastern part of the North Sea, the

potential nurseries, abundance of larger herring larvae in 2023 was lower than in the two previous years. An interesting feature of the 2023 spatial distribution are the few stations with very high abundances in the English channel/Southern Bight area, which have a relatively strong impact on the index value.

Since 2017, this 0-ringer index (also called MIK index) time series is calculated with a new algorithm, which excludes larvae of Downs origin more rigorously. This is done by excluding the smaller larvae – presumably of Downs origin – from the analyses in certain parts of the survey area. Index values are calculated as described in detail in the Stock Annex. (Note that this new time-series based on the new algorithm only dates back to 1992, and that all French data before 2008 are excluded because of data quality issues). The index from the 2023 survey (corresponding to the 2022 year-class) is 90.8. This corresponds to an average index value, and is a bit below the long-term average of 100.7 (in the time-series since 1992). The index values for the entire time series can be found in the reports of the Herring Assessment Working Group for the Area South of 62°N (HAWG).

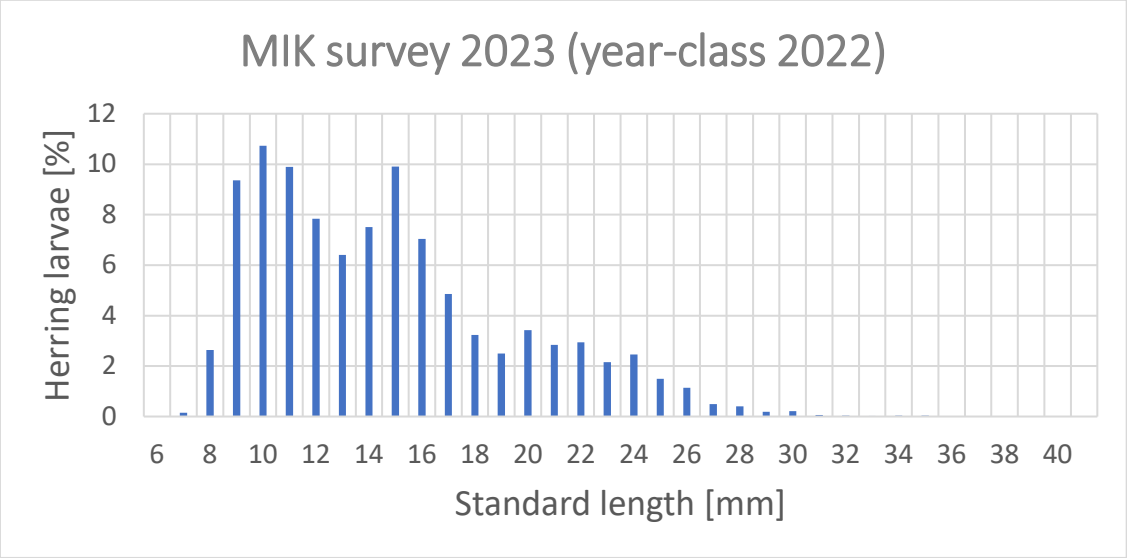

Figure 1.6 North Sea herring. Length distribution of all herring larvae caught during the 2023 Q1 IBTS.

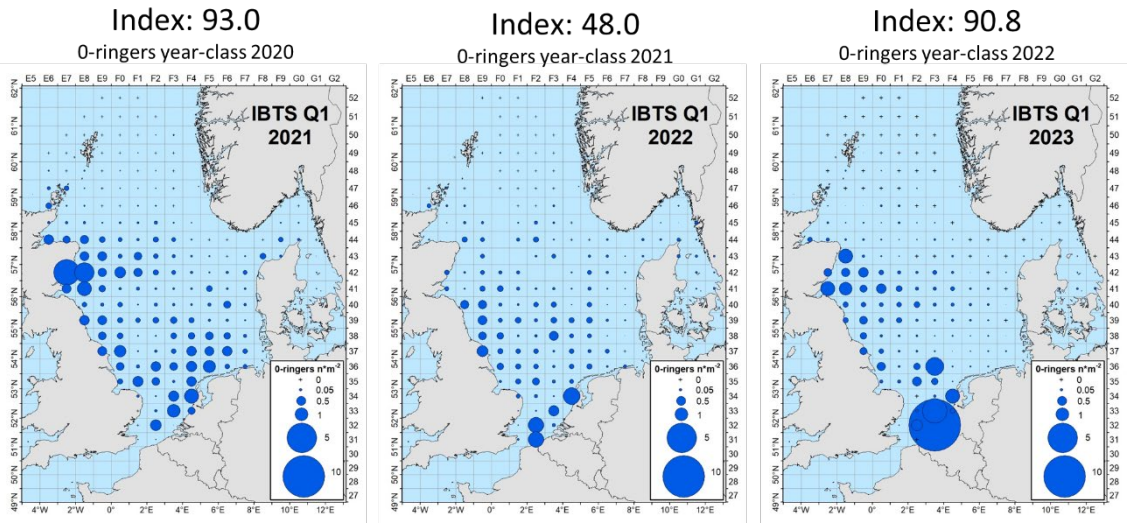

Figure 1.7 North Sea herring. Distribution of 0-ringer herring, year classes 2020–2022. Density estimates of 0-ringers (>18 mm) within each statistical rectangle are based on MIK catches during IBTS in January/February 2021–2023. Areas of filled circles illustrate densities in no m-2.

1.2.4 Sardine larvae

As in previous years, sardine larvae were again found in the samples of the 2023 MIK survey. Most sardine larvae occurred in the southern and south-eastern North Sea as well as in the Skagerrak. However, in contrast to previous years, some sardine larvae were also found relatively far north and north-west.

1.2.5 Planning & Coordination of the 2024 MIK sampling during the Q1 IBTS

MIK sampling will be carried out during the night time of the 2024 first quarter IBTS (IBTS Q1). The IBTS Q1 survey coordinator circulates the survey plan during December 2023. MIK participants are now requested to submit their data directly to the ICES Eggs and larvae database in due time (i.e. 7 - 10 days) before the HAWG meeting.

ADDITIONAL SAMPLES TO BE COLLECTED FROM THE Q1 MIK HAULS:

Other fish larvae species & Marine litter: As in previous years, other fish larvae species and marine litter should be collected from the MIK samples.

NEW IN 2024 - CEPHALOPODS: At WGSINS 2023, the chair of WGCEPH gave a presentation on the general lack of information about early life stages and spawning areas of cephalopods in the North Sea (see also section 3.4). In order to start filling this knowledge gap, it was suggested to collect cephalopods from the MIK samples, and all MIK participants agreed to conduct this additional sampling. Samples should be preserved - preferably in ethanol - and sent to the chair of WGCEPH for further species identification and analysis.

Gelatinous zooplankton: Denmark has registered data on gelatinous zooplankton (species, numbers & sizes of jellyfish & ctenophores) from the Q1 MIK since 2014 and Sweden and Germany have also contributed in recent years. In order to improve the spatial coverage, other participants in the MIK surveys are encouraged to collect data on gelatinous zooplankton as well.

1.2.6 The MIKeyM net sampling

Since 2012, eggs are collected along with the MIK sampling using the MIKey M net (MM, ICES, 2018). In 2023, MM samples were obtained by six of the countries participating in the IBTS 1Q. MM samples were taken with every MIK sample when possible. The status of sample analyses varied between institutes, ranging from fish eggs identified where possible, staged and measured to still needs to be sorted.

1.2.7 Planning for the 2024 MIKey M net sampling

As in previous years, MM net sampling is planned to be carried out along-side MIK sampling during the first quarter IBTS in the North Sea. For 2024, all institutes are asked to carry out at least two MIKey M net hauls (1 with every MIK haul) in each ICES statistical rectangle. However, there is no requirement for these samples to be worked up this year. The intention is to retain a reservoir of samples that can be used if interesting questions arise concerning egg and larvae distributions in the North Sea and Skagerrak or if there is a need for an uninterrupted time series of egg or larvae data. These samples should be stored at the respective institutes. Those institutes with sufficient resources will work up their samples and inform the rest of the group as to what they have done. The intention, as in previous years, is that every other haul per rectangle should be worked up according to the MM manual. The remaining plankton can then be discarded. All samples that are not sorted for fish eggs and larvae shall be stored at the respective institutes. In addition, the WG will consider a suitable time frame for retaining these samples for future analyses. Sweden will be requested to undertake MIKey M sampling to provide coverage of the Skagerrak and Kattegat area.

1.3 The Downs Recruitment Survey (DRS)

1.3.1 Survey in 2023

In 2023 the Downs Recruitment Survey (DRS) was carried out following the IBTS-MIK protocol (ICES 2017) as much as possible, but the sampling was carried out both day and night, instead of only at night. Because of the daylight sampling, a blue netting material instead of the usual black fabric is used. In 2023 both Netherlands and Norway participated in the survey

The survey was conducted from 24 April – 5 May, sampling 69 stations in total (Figure 1.8).

Herring larvae distribution was different from previous surveys (Figure 1.8 and Figure 1.9) with highest numbers found in the southern North Sea and some larvae North of the Netherlands and in the southern German Bight. On 24 stations no herring larvae were caught. Contrary to other years, high numbers of sprat larvae were found in all samples (Figure 1.10). All samples also contained high volumes of jellyfish, and other larvae, such as sandeel, gadoid and flatfish.

Length distributions of the herring larvae in the DRS was similar to previous surveys (Figure 1.11).

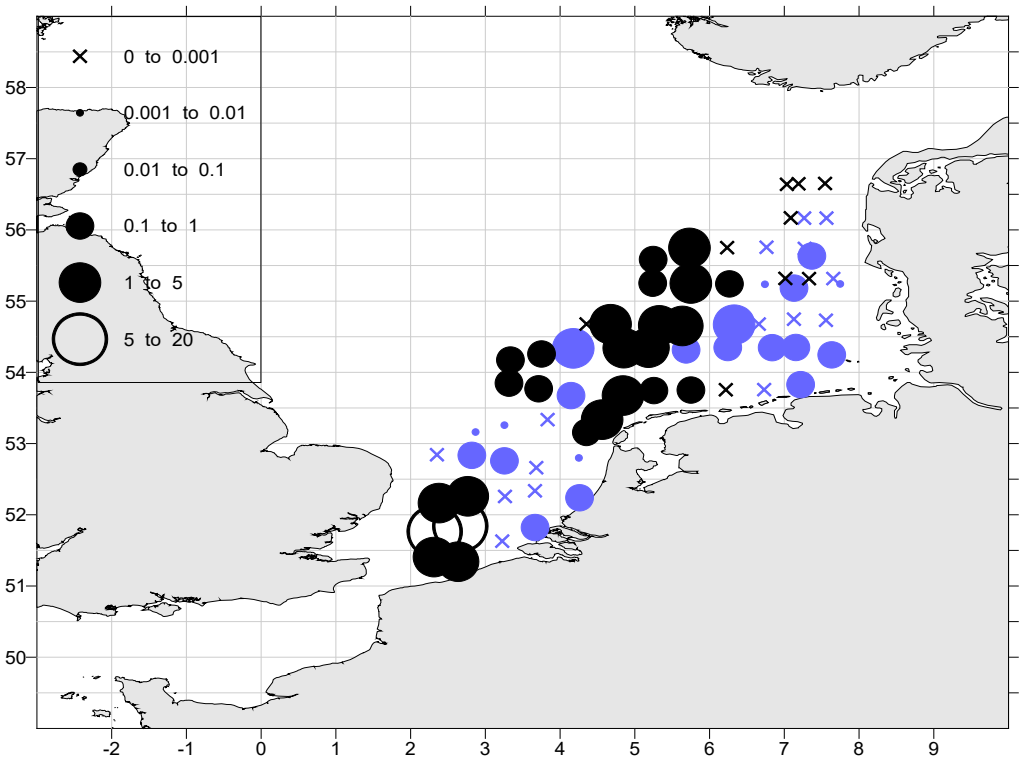

Figure 1.8. Herring larvae distribution by haul from the 2023 DRS; blue is day light samples, black is night time sampling.

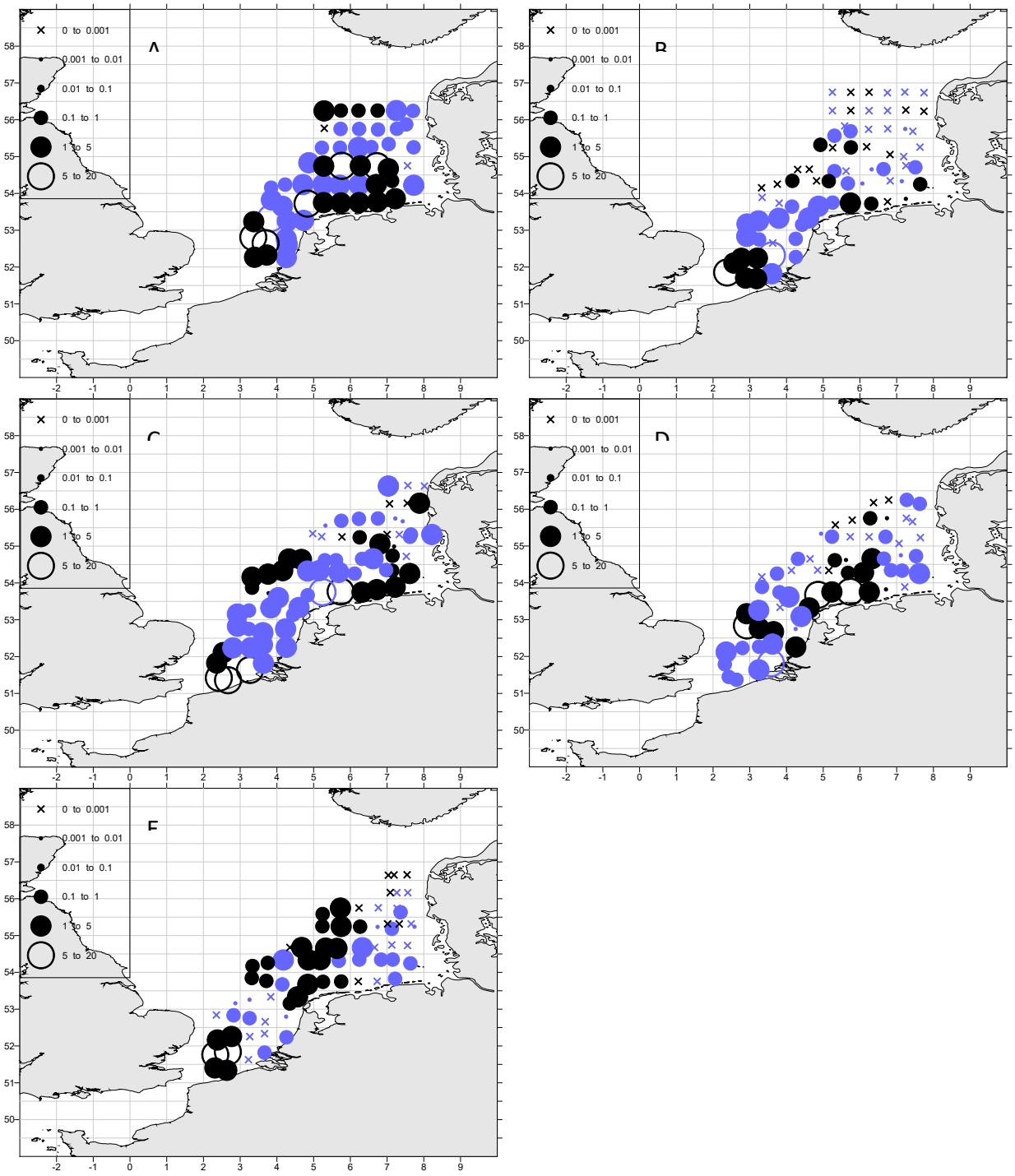

Figure 1.9. Herring larvae distribution for the time series, 2018-2023; blue is day light samples, black is night time sampling. (Note: No survey was carried out in 2020.)

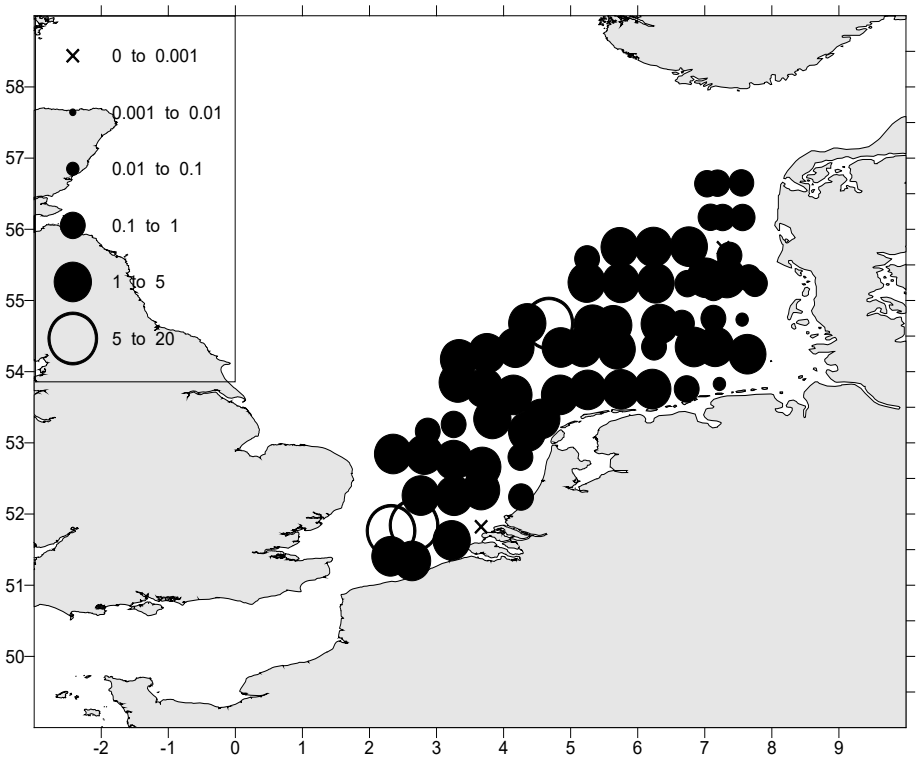

Figure 1.10 Sprat larvae distribution by haul from the 2023 DRS

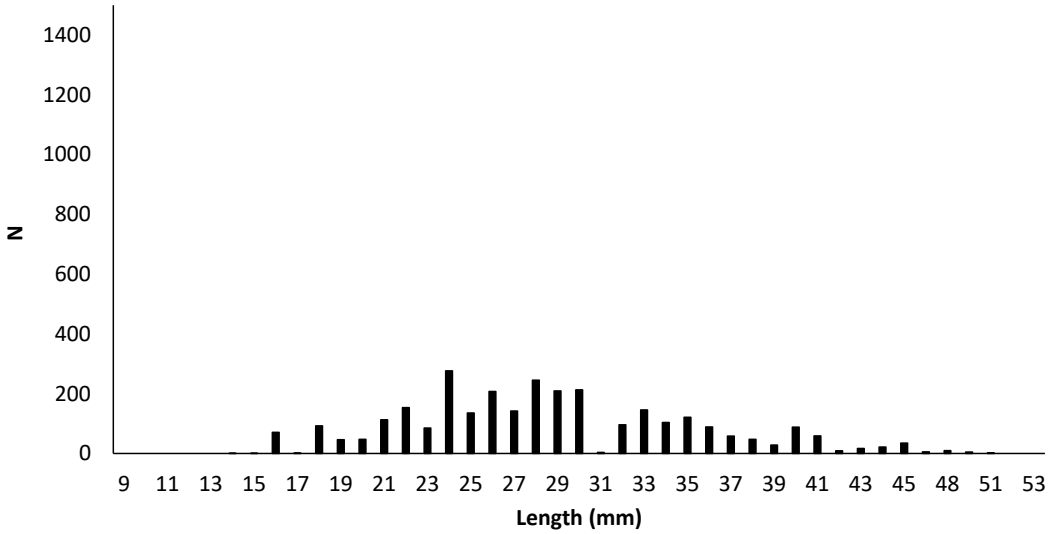

Figure 1.11 Herring larvae length distribution from the 2023 DRS.

1.3.2 Preliminary results on indices calculations

Indices were calculated following the MIK manual (ICES 2017): herring larvae abundance per haul are first raised to numbers per ICES rectangle, and then raised the North Sea MIK subarea (ICES 2017). However, the DRS only samples parts of the MIK-areas SouthEast (se) and SouthernBight (ch). The MIK and DRS indices were summed to a combined index (Table 1.4).

When using the MIK areas for the calculation the index is 11 to 84% higher compared to using only the area sampled (Table 1.4). In three years of the time series the DRS index is much higher compared to the MIK index (Table 1.4)

Table 1.4 DRS and MIK time series from 2018-2023 using the current index calculation (ICES 2017). DRS index is calculated using the MIK areas. (Note: No DRS survey was carried out in 2020.)

Year[1]	Year class	DRS	IBTS-MIK	Combined IBTS-MIK-DRS
2018	2017	156.3	102.2	258.5
2019	2018	27.1	51.6	78.7
2021	2020	191.1	93.0	284.1
2022	2021	143.4	48.0	191.4
2023	2022	61.6	90.8	152.4

As the DRS only samples part of the North Sea a new modelling approach was tested using a GAM model for both DRS and MIK time series. The below model was used for the estimation of herring larvae abundance:

$$Abundance = te(StartLatitude,\ StartLongitude, k = 5, m = c(1, 0.5), by = Year) + Yearclass + Day.Night + s(sqrt(DepthLower), bs = "ds', k\ =\ 5, m = c(1,0))\ + offset \log(VolumeFiltInt)$$

A relative index was estimated with the first year of the DRS time series set at 1. The indices were estimated for the DRS, MIK separate and combined MIK-DRS time series. The separate indices allowed for comparison of the new proposed MIK index with the current estimation, which were very similar. The combined MIK-DRS index using the GAM modelling is shown in Figure 1.12. The new GAM modelling approach will be presented to the herring assessment working group in 2024.

[1] No sampling was carried out in 2020 due to Covid-19 measures

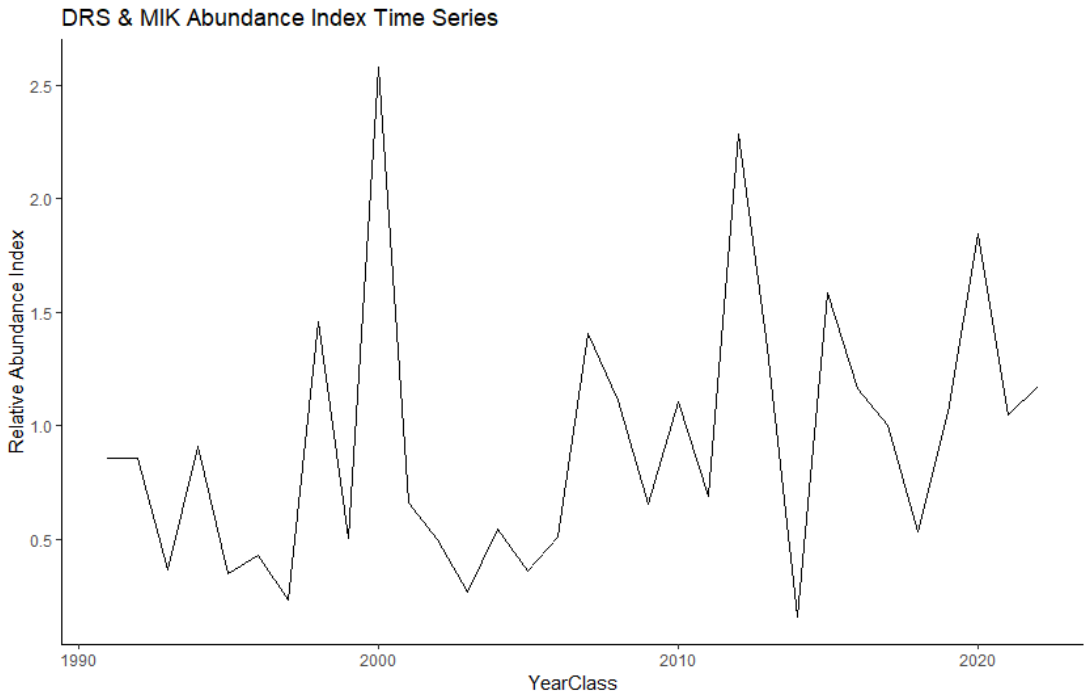

Figure 1.12 Combined MIK-DRS index series, before year class 2017 only MIK data is available, from 2017 onwards both MIK and DRS data is used.

1.3.3 Comparative sampling

Because sampling is done during day and night a blue midwater ring trawl was used. It was expected that a blue net would be less visible during day time compared to a black net, and this would reduce the chance of larvae trying to escape the net. It was, however, recommended to carry out comparative sampling with both nets and to check for differences in catchability during day and night.

In 2021, 2022 and 2023 comparative sampling was carried out. Due to technical issues only few samples were taken in 2022. Full comparative sampling could be done in 2021 and 2023.

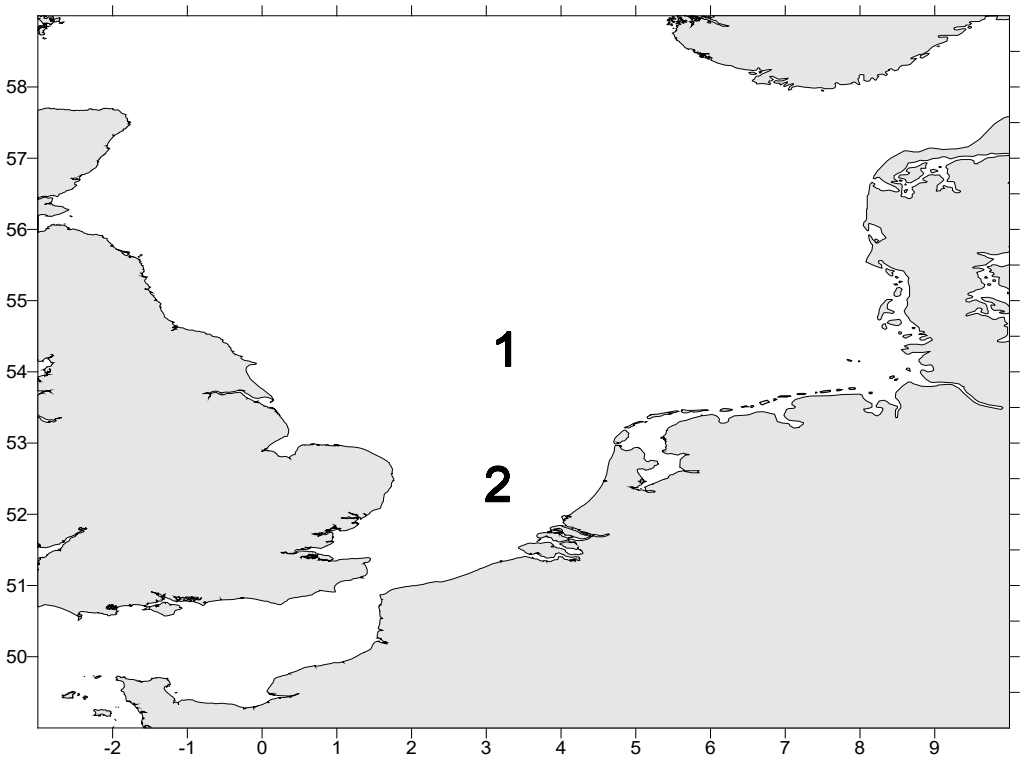

Figure 1.13 Position of stations for comparative sampling with the blue and black midwater ring trawl.

Results show that there is no significant difference in catchability between the black and blue net, but large significant difference between day and night sampling (Figure 1.14). Based on these results it was agreed that in future DRS sampling should only be done during night time and can be done with blue or black ring trawl. However, in order to keep the sampling as similar to the MIK and as not all institutes have a blue ring trawl, it is advised to use a black midwater ring trawl.

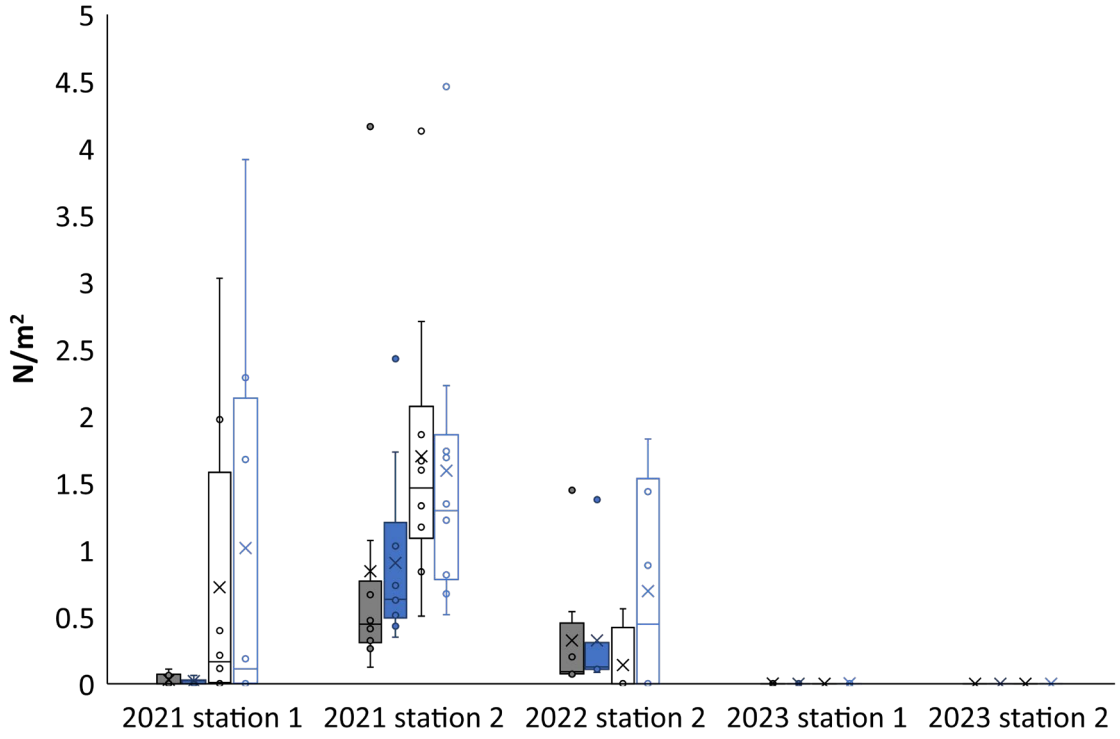

Figure 1.14 Numbers of herring larvae caught at the two stations in 2021, 2022 and 2023. Closed boxplots are day time sampling, open boxes night time sampling, black is the black and blue is the blue ring trawl.

1.3.4 Planning for the 2024 survey

In 2024 the DRS sampling will be carried out at night only. The Netherlands will carry out a Downs Recruitment survey from 15 – 26 April 2024. Norway will try to participate again like in 2023. Germany plans to sample four nights from 15 – 19 April. Participation of our countries is uncertain at the moment. A plan for the international sampling distribution will be prepared in Q1 2024 in discussion with the participating institutes.

1.4 The Northern Irish Northeastern Larvae Survey (NINEL)

1.4.1 Background information

Herring larvae surveys of the northern Irish Sea (ICES area 7aN) have been carried out by the Agri-Food and Biosciences Institute (AFBI), formerly the Department of Agriculture and Rural Development for Northern Ireland (DARD), in November each year since 1993. The surveys are conducted on-board the RV "Corystes" since 2005 and prior to that on the smaller RV "Lough Foyle". Sampling is carried out on a systematic grid of stations covering the spawning grounds and surrounding regions throughout the north Irish Sea (Figure 1.20). Larvae are sampled using a Gulf7 high-speed plankton sampler with 280µm net and on-board Valeport Midas+ CTD. Mean catch-rates (nos.m-2) are calculated over stations and strata to give area specific indices of abundance. Larval production rates and birth-date distributions are computed based on the mean

density of larvae by length class. A growth rate of 0.35 mm per day and instantaneous mortality of 0.14 per day are assumed based on estimates made in 1993–1997. The index has been historically used as an indicator of spawning-stock biomass (SSB) in the assessment of Irish Sea herring by the ICES Herring Assessment Working Group (HAWG). The assessment of this stock was benchmarked in 2012 and issues concerning the survey raised. Specifically, the survey index exhibited a diverging trend in SSB from that observed in Irish Sea herring acoustic surveys, not indicating the increasing SSB confirmed from all the repeated acoustic surveys (ICES, 2012).

NOTE: The 2023 WGSINS report presents summaries and results from the 2022 and 2023 NINEL survey. In preceding WGSINS reports the NINEL survey summary covered the previous year. With the timing of the survey in relation to the working group it is from now on possible to report on in year results.

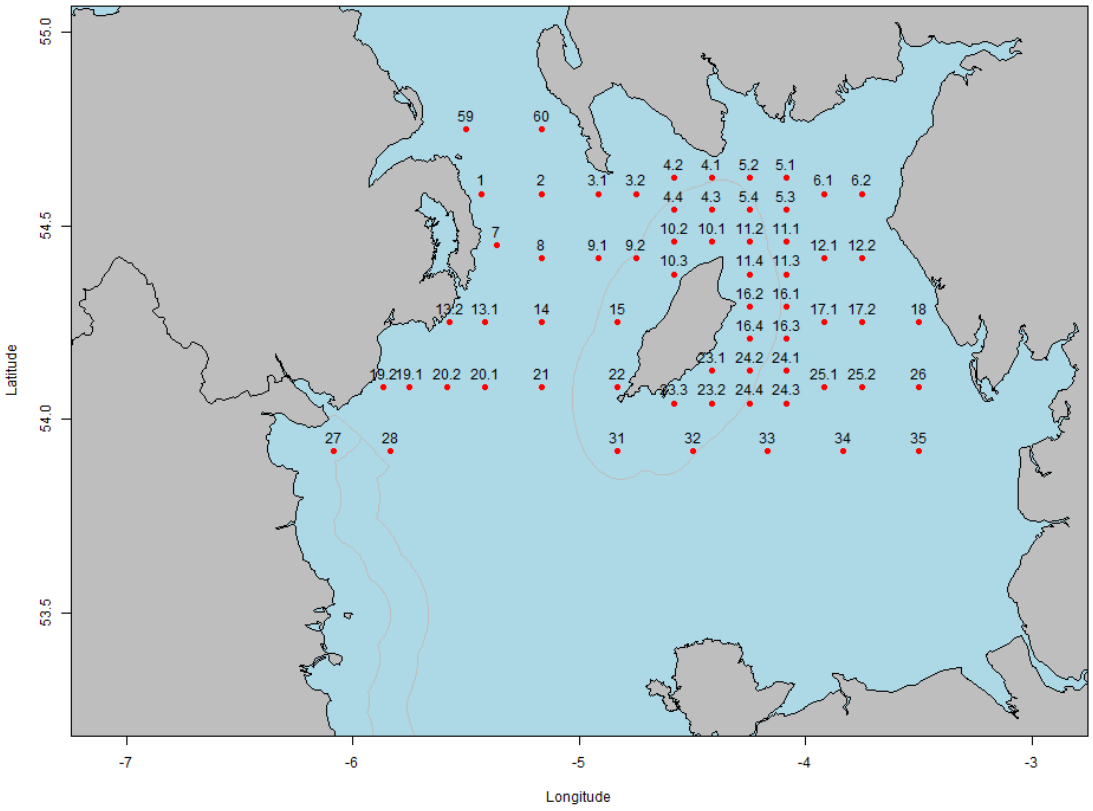

Figure 1.15 Station positions for NINEL survey.

1.4.2 Survey Results in 2022

The 2022 NINEL survey was completed during 8-13th November with a total of 50 Gulf7 stations sampled out of a planned 62 stations. Overall survey coverage was impacted by strong southerly gales that resulted in loss of sampling time while the vessel sheltered. The influential stations based on historical larvae distribution were sampled however. 1234 herring larvae were sorted from samples, with a subsample measured prior to preservation in alcohol. Depth profiles of salinity and temperature were collected at all stations, and remaining plankton samples preserved. Station 27 was not sampled due to permissions not being sought to enter ROI waters.

As in previous years the majority of larvae were captured in the eastern Irish Sea, in the vicinity of the Douglas bank spawning ground (Figure 1.16). Larval lengths ranged in size from 6.1 to 22 mm, with modal lengths of ~10.0mm in the area of Douglas bank (Figure 1.17). The overall abundance of larvae was low for the survey, with very few larvae found along the Mourne spawning ground. A number of larvae were individually stored in alcohol as a part of a stock discrimination study.

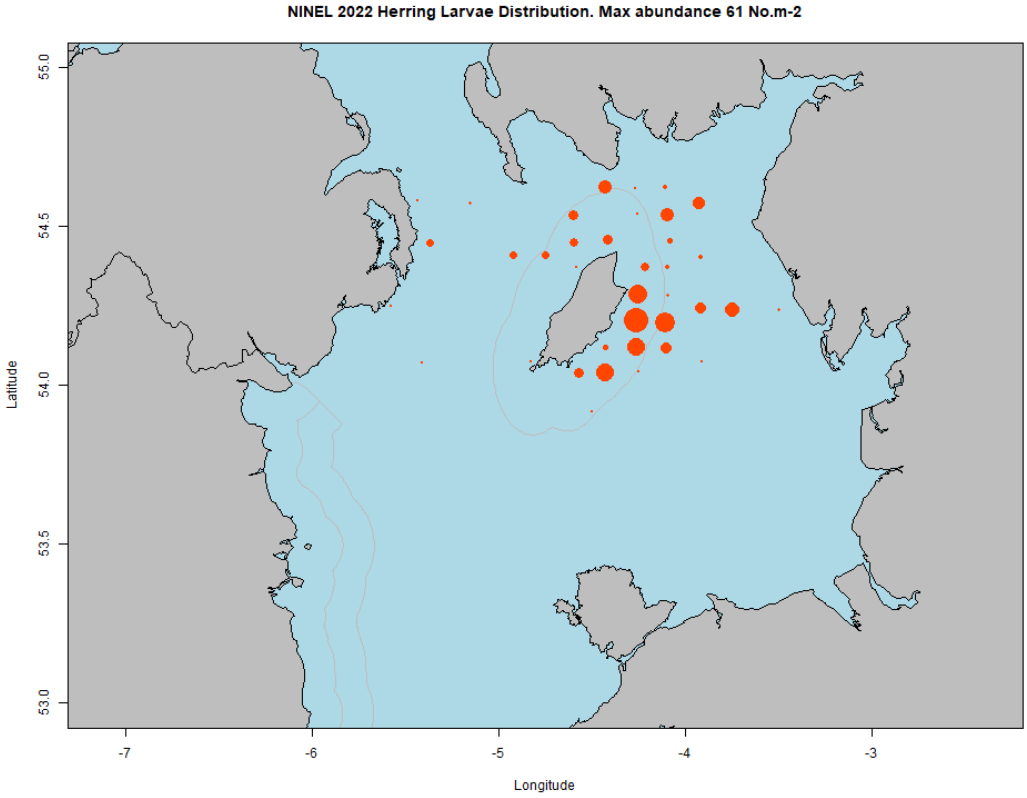

Figure 1.16 Abundance of herring larvae captured during the 2022 NINEL. Maximum abundance 61 no.m^{-2}.

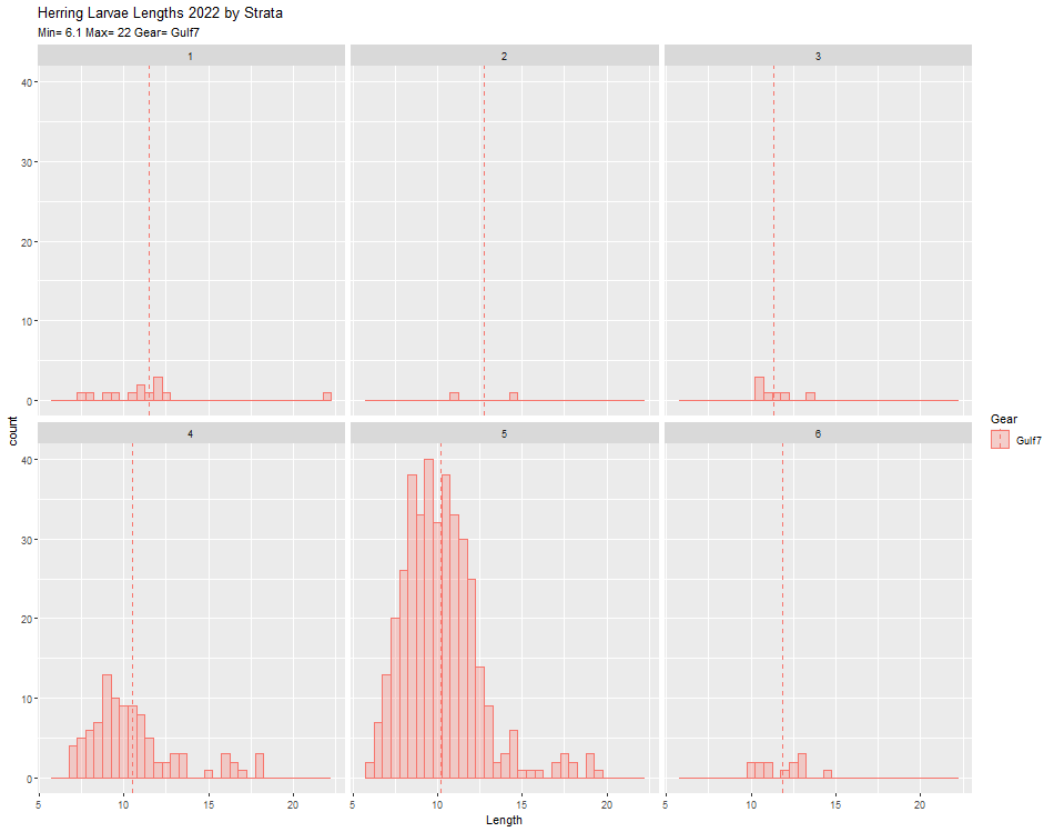

Figure 1.17 Length frequency of larvae removed from Gulf7 samples during NINEL 2022, total per strata.

1.4.3 Survey Results in 2023

The 2023 NINEL survey was completed during 6-10th November with a total of 62 Gulf7 stations sampled. Overall survey coverage was good despite strong southerly winds throughout the survey. Herring larvae were distributed throughout the eastern Irish Sea, with highest catches caught north of the Isle of Man and east of the Douglas Bank spawning ground. A concentration of larvae where detected along the Irish coastline, in the vicinity of the Mourne spawning ground (Figure 1.18). Larvae densities were high with 5660 herring larvae removed from samples, with a subsample measured (Figure 1.19) prior to preservation in alcohol. Depth profiles of salinity and temperature were collected at all stations, and remaining zooplankton samples preserved. As in 2022, station 27 was not sampled due to permissions not being sought to enter ROI waters.

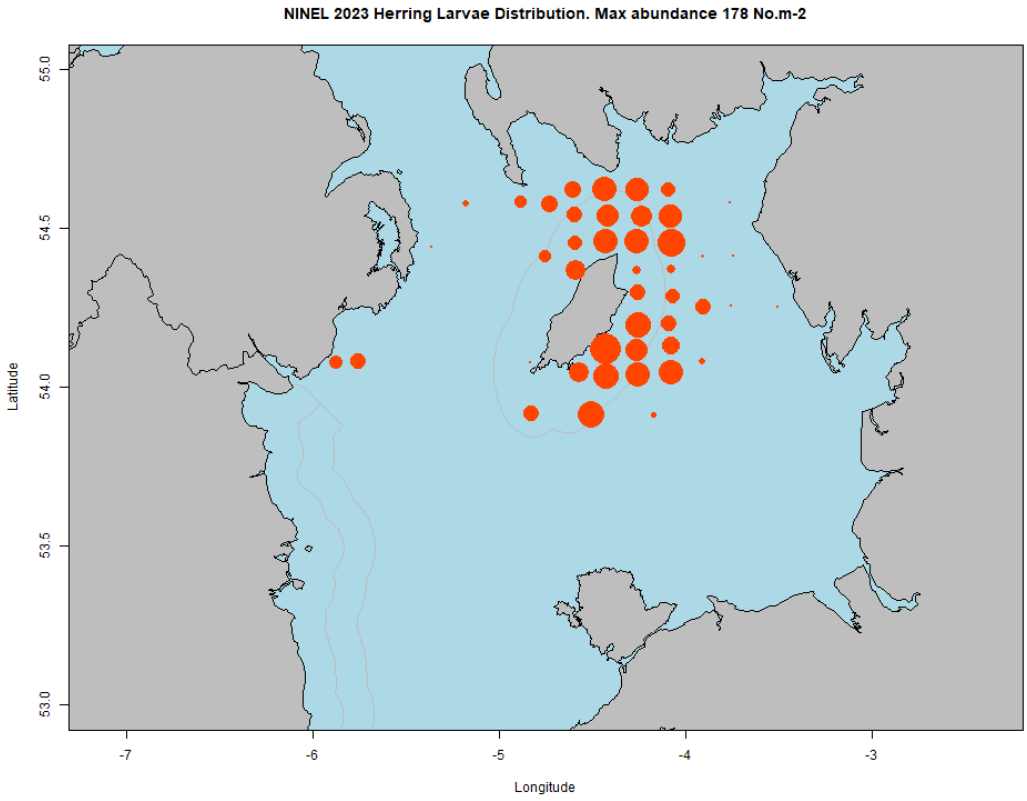

Figure 1.18 Abundance of herring larvae captured during the 2023 NINEL. Maximum abundance 178 no.m-2.

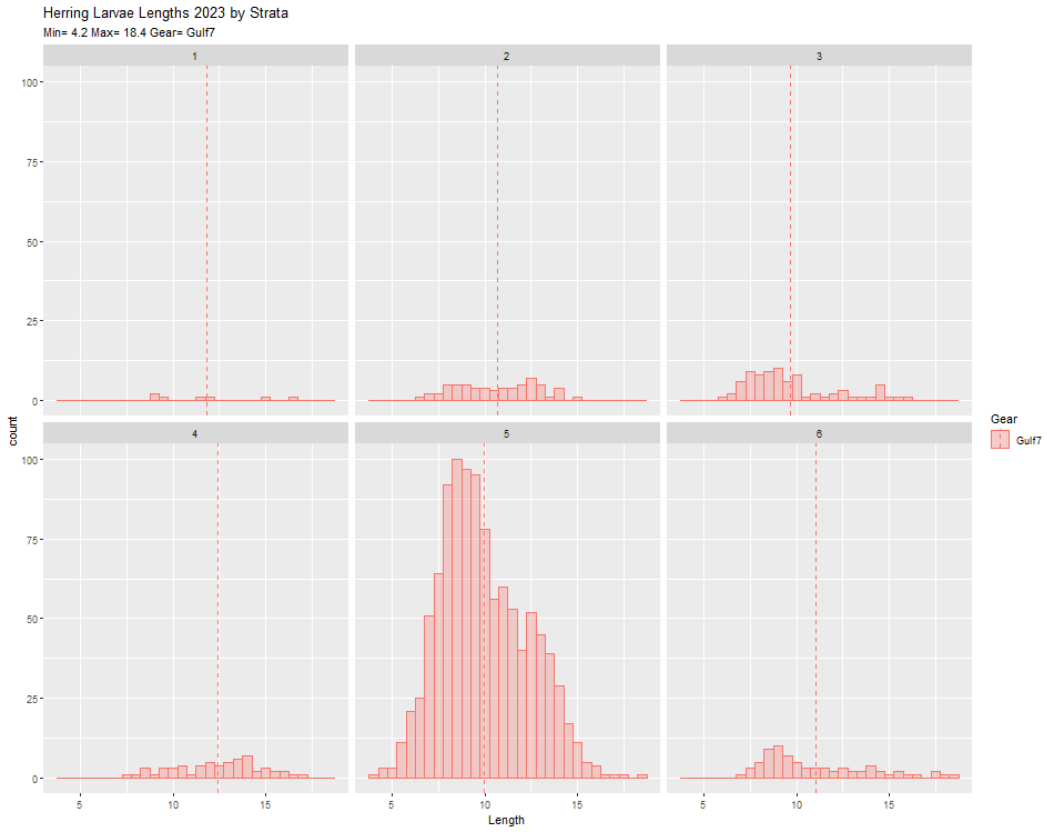

Figure 1.19 Length frequency of larvae removed from Gulf7 samples, total per strata NINEL 2023.

1.5 The Northern Ireland MIK Survey (NI-MIK)

1.5.1 Background information

The survey previously used a modified Methot-Isaacs-Kidd frame trawl to target pelagic juvenile gadoids (whiting, cod, haddock) in the Irish Sea between 1993 - 2018. The modified Methot-Isaacs-Kidd frame was replaced with a 2m midwater ring net in 2019 (ICES 2017). The survey is a stratified design and takes place in May and June during the period prior to settlement of gadoid juveniles. Indices are calculated as the arithmetic mean of the numbers per unit sea area (no.m^{-2}). The MIK net is deployed during the hours of darkness (max. 30 mins$\pm$ hr sunset). During daylight hours a Gulf7 high speed plankton sampler with on-board Valeport Midas+ CTD is deployed. Density and distribution data on larval fish, zooplankton and water structure properties (SST, salinity, chlorophyll *a*) are recorded. While the main objective of the survey is to provide recruitment information on gadoids, the survey provides the opportunity and tools to collect valuable information on the wider ecosystem. For example, data collected on the survey has provided the basis for the development of a 20+ year time-series of gelatinous zooplankton abundance in the Irish Sea. Since 2018 a standard WP2 frame with side floats for neuston sampling (333 µm mesh size) has been deployed for the study of marine micro plastics at a number of the Gulf7 stations.

1.5.2 Survey Results in 2023

The 2023 NIMIK survey coverage was restricted to UK waters due to noncompliance of the vessel with the international ballast water management convention. The vessel subsequently was not able to enter ROI waters where traditionally juvenile gadoids are caught in high numbers. This undoubtedly has an impact on the ability of the survey to detect trends in 2023 gadoid recruitment in the region. To reduce the impact of the area restrictions a number of stations were relocated within the western Irish Sea survey area to ensure sampling levels remained high in UK waters. The NIMIK survey is timed to coincide with the pre-settlement stage of juvenile gadoids in the western Irish Sea (Figure 1.20 - Figure 1.21).

Despite the issues above it is noted that this was the 2nd year in which no juvenile cod (*Gadus morhua*) were caught in the region (Figure 1.22). The current level of recruitment of Irish sea cod maybe at its lowest point since the survey began in 1994. This suggests cod in the Irish Sea continues to struggle in the face of possible anthropogenic and climatic pressures. Alternatively, the reduced survey coverage in recent years has impacted the surveys ability to track cod recruitment or local populations have adapted their spawning behaviours.

In 2023 the 111 GulfVII and 80 MIK stations provided important data on the pelagic habitat and organisms within, including Euphausiids and gelatinous zooplankton. Additionally, a further 79 neuston net samples were collected, providing information on the presence of marine micro plastics in the Irish Sea. These samples also demonstrated a high abundance of crab larvae in the area. The increasing abundance of *Solea solea* larvae in the eastern Irish Sea is also a possible useful indictor of recruitment for this species in the VIIa management area.

A number of images of fish larvae for QA and training purposes were taken, while larvae were also selected and preserved for future genetic analysis.

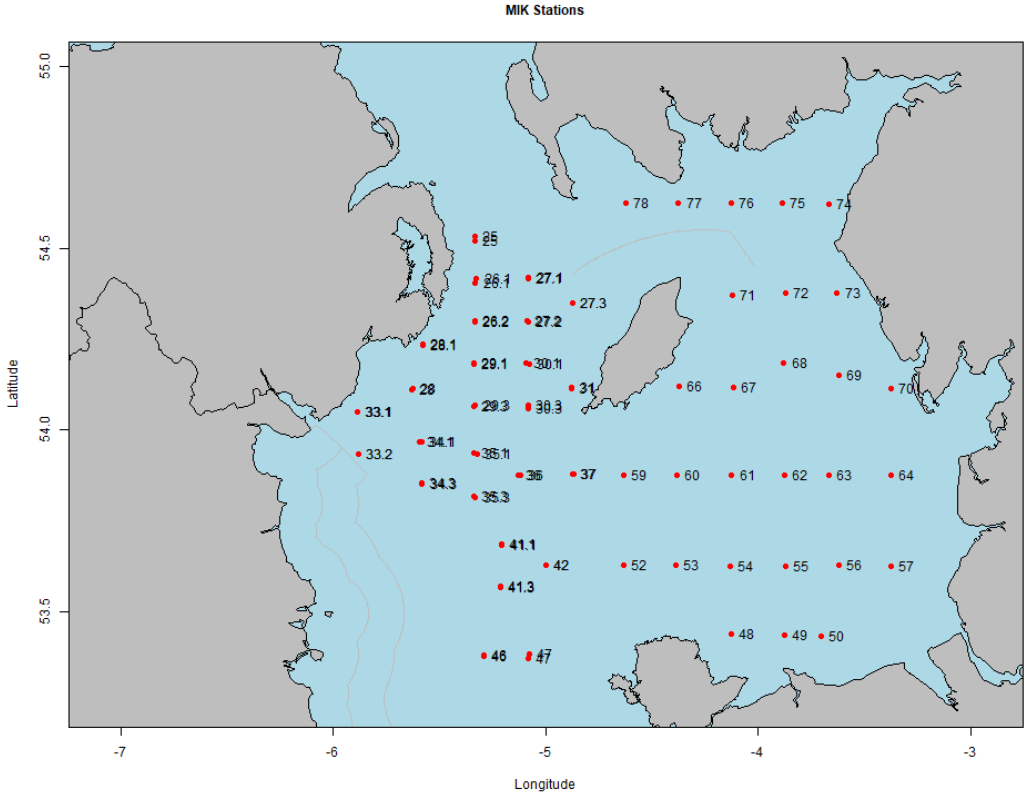

Figure 1.20 MIK Station positions during 2023 NIMIK survey.

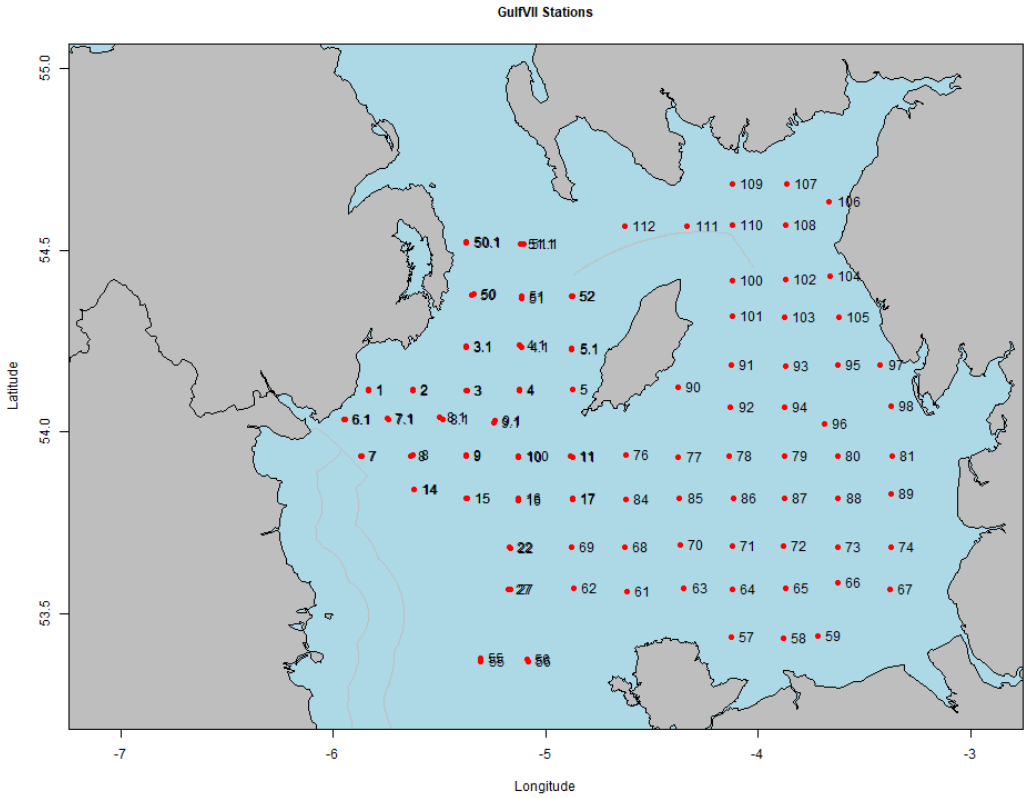

Figure 1.21 Gulf7 station positions during 2023 NIMIK survey.

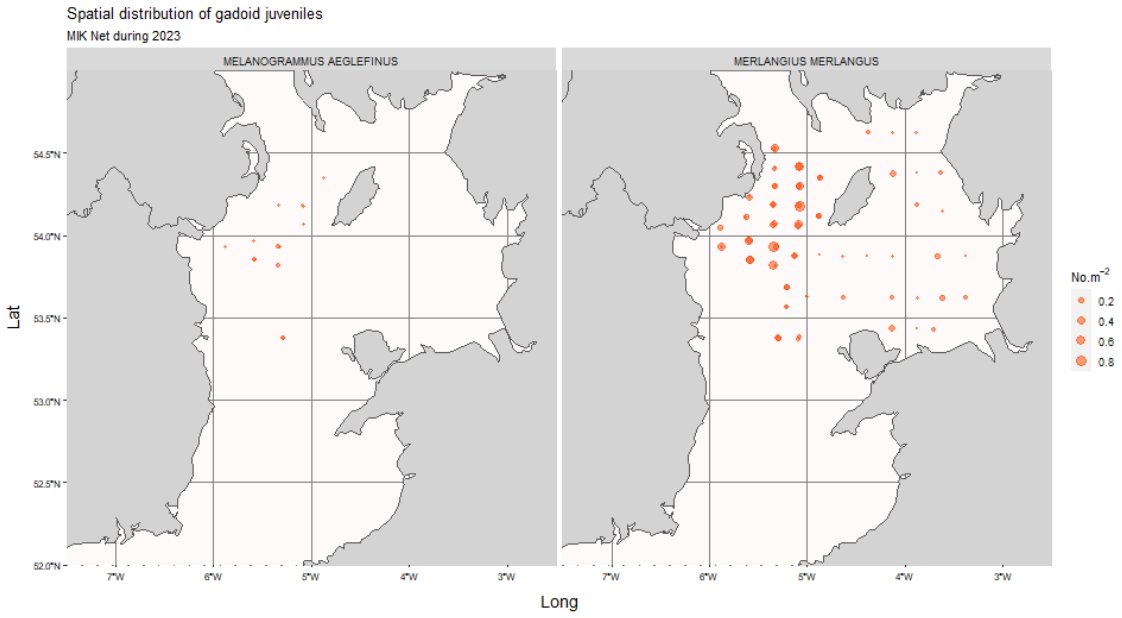

Figure 1.22 Spatial abundance (No. m-2) of juvenile gadoids haddock (Melanogrammus aeglefinus) and whiting (Merlangius merlangus) NIMIK 2023.

1.6 The Rügen Herring Larvae Survey (RHLS)

1.6.1 The RHLS

The waters of Greifswald Bay (ICES area 24) are considered a major spawning area of Western Baltic spring spawning (WBSS) herring. The German Thünen Institute of Baltic Sea Fisheries (TI-OF), Rostock, and its predecessor monitors the density of herring larvae as a vector of recruitment success since 1977 within the framework of the Rügen Herring Larvae Survey (RHLS). It delivers a unique high-resolution dataset on the herring larvae ecology in the Western Baltic, both temporally and spatially. Onboard the research vessel FFS CLUPEA a sampling grid including 35 stations is sampled weekly using ichthyoplankton gear (Bongo-net, mesh size 335 µm, Figure 1.23) during the main reproduction period from March to June. The weekly assessment of the entire sampling area is conducted within two days (detailed description of the survey design can be found in Polte 2013, ICES WD08). The collected data provide an important baseline for detailed investigations of spawning and recruitment ecology of WBSS herring spawning components. As a fishery-independent indicator of stock development, the recruitment index is incorporated into the assessment of the ICES Herring Assessment Working Group (HAWG).

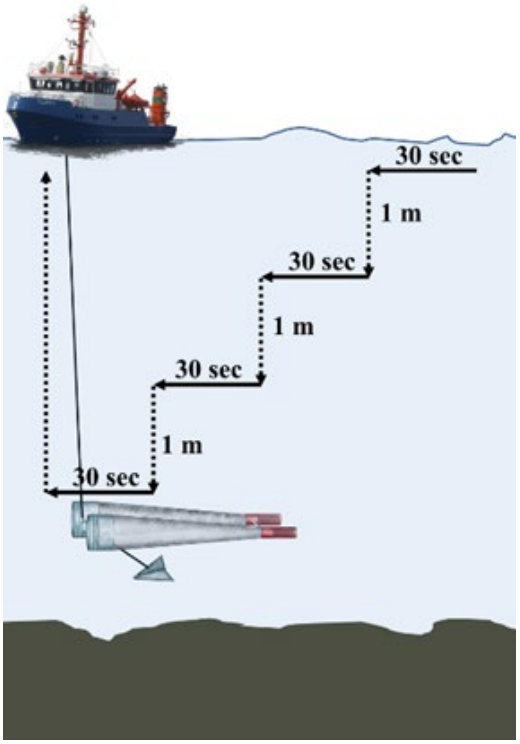

Figure 1.23 Schematic of the Bongo net sampling procedure during the RHLS. Note that min. water depth is 4 m (10 m max.). Limit of the haul depth is 1 m above ground. Towing speed is 2 knt.

The rationale for the *N20* recruitment index is based on strong correlations between the amount of larvae reaching a length of 20 mm (TL) in Greifswald Bay and abundance data of juveniles (1-wr and 2-wr fish) as determined by acoustic surveys in the Arkona and Belt Seas (GERAS).

This correlation supports the underlying hypotheses that i) major variability of natural mortality occurs at early life stages before larvae reach a total length of 20 mm and ii) larval herring production in Greifswald Bay is an adequate proxy for annual recruitment strength of the WBSS herring stock.

The *N20* recruitment index is calculated every year based on data obtained from the RHLS. This is done by estimating weekly growth of larvae for seasonal temperature change and taking the sum of larvae reaching 20 mm by every survey week until the end of the investigation period. On the spatial scale, the 35 sampling stations are assigned to 5 strata and mean values of stations for each stratum are extrapolated to the strata area (for details see Oeberst et. al 2009).

Calculation procedures have been externally reviewed in 2006 and 2011. Consequently, the survey design was refined in 2007. Accordingly, the recalculated index for the time series from 1992 onwards is used by HAWG since 2008 as 0-group recruitment index for the assessment of Western Baltic Spring Spawning herring.

1.6.2 2022 N20 index

The regular Rügen-herring larvae Survey started on February 28th and continued weekly for 16 weeks until June 15th 2022 including a total of 560 stations/hauls. An additional cruise in mid-February (winter control) had to be cancelled due to ice cover. An additional cruise in November (autumn control) was performed from 14.11. to 25.11. 2022.

With an estimated product of **6603 million** larvae, the 2022 *N20* recruitment index is more than 25 times higher than that of the record low in 2020 and the highest value since 2010 (Table 1.5, Figure 1.24).

Table 1.5 N20 larval herring index for spring spawning herring of the Western Baltic Sea (WBSS), generated by RHLS data.

Year	N20 (Millions)	Year	N20 (Millions)	Year	N20 (Millions)
1992	660	2003	4775	2014	681
1993	4542	2004	6818	2015	3001
1994	15158	2005	5118	2016	482
1995	9327	2006	4173	2017	1247
1996	24540	2007	1986	2018	1563
1997	5290	2008	1903	2019	1317
1998	18782	2009	7989	2020	239
1999	22342	2010	8004	2021	2751
2000	3404	2011	4493	2022	6603
2001	5670	2012	1340		
2002	12452	2013	3588		

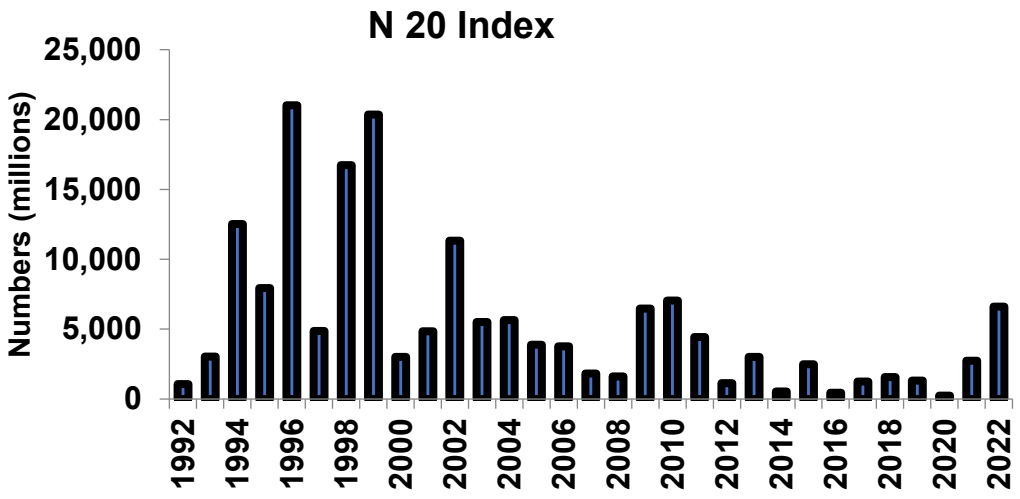

Figure 1.24 Time series of the N20 index (1992-2022). Time series average: 5,400 millions.

1.6.3 2022 additional survey observations

According to former observations on the impact of winter SST on spawning phenology and herring early life stage survival (Gröger et al. 2014, Polte et al. 2021), the reasons for the higher N20

index compared to the previous year can be speculated being related to relatively cold February-temperatures, most probably resulting in a comparatively positive spawning phenology. Additionally, the fishery was almost closed in the area. This might have increased the number of eggs spawned in the area; however, it does not necessarily explain improved survival of larvae throughout their critical period.

1.6.4 Relation between N20 and GERAS 1-wr herring

Correlation between N20 and GERAS 1-wr herring

Figure 1.25 shows the correlation between the N20 index and the 1-group monitored during the German hydroacoustic survey (GERAS) in October of the following year. After multiple years with the record low N20 (2014, 2016, 2020), the relation with the 1-group juveniles as monitored by the GERAS was re-evaluated to see if recent years with extremely low larvae production are reflected in the abundance of the 1-group juveniles of WBSSH in SDs 21-24. The results reveal that recent years resulted in a lower abundance of 1-wr juveniles detected during the GERAS compared to the period before 2019.

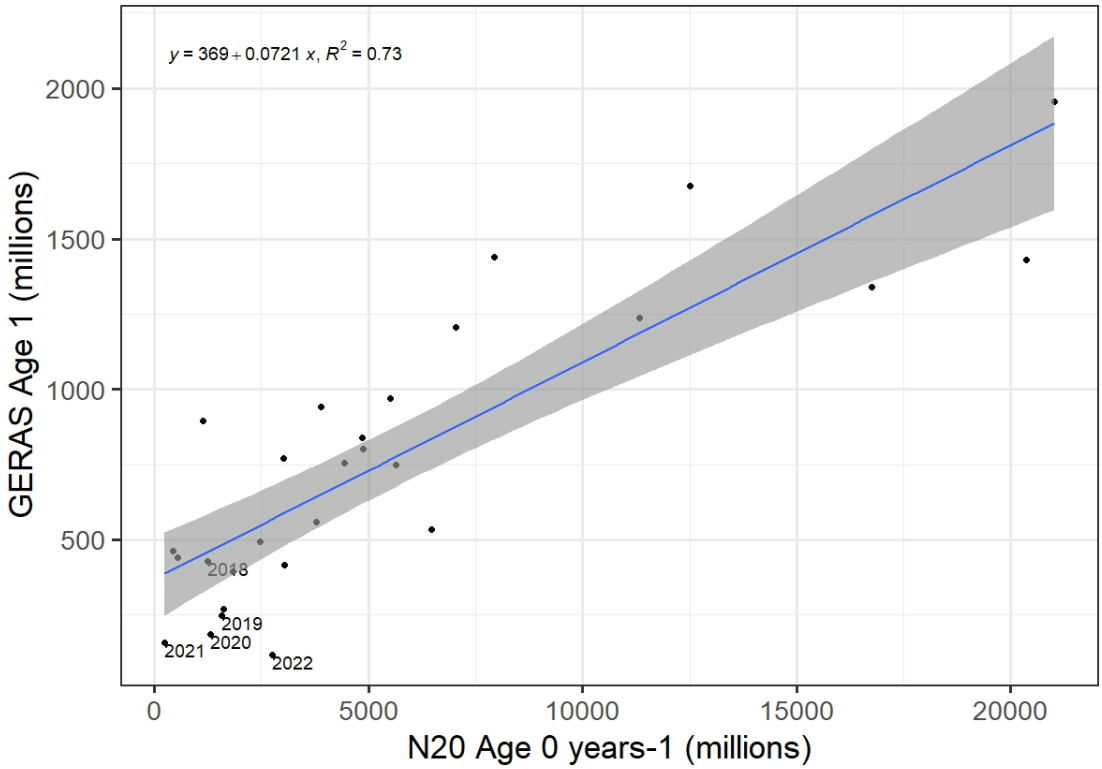

Figure 1.25 Correlation of N20 larvae index (1993-2021, excl. 2000) with the 1-wr herring from GERAS (1994-2022 excl. 2001 as SD 23 was not covered in that year). Note the one-year lag phase between indices, i.e. the exceptionally low N20 year 2020 is represented by the GERAS 1-wr index 2021. The years 2018-2022 are labelled.

1.7 The Baltic Ichthyoplankton Surveys (BIS)

1.7.1 Background information about ichthyoplankton surveys in the Baltic

Ichthyoplankton surveys in the Baltic have a long tradition, dating back to egg studies by Hensen & Apstein as early as the late 1800s and early 1900s. Starting in 1904, Ehrenbaum & Strodtmann have conducted more or less regular egg and larvae surveys for several years, followed by the surveys of Kändler, Mielck & Künne in the 1920s and 1930s as well as a series of surveys by Grauman, Bagge & Müller in the 1970s and early 1980s (e.g. Bagge *et al.* 1994). Already in these early days of ichthyoplankton surveys in the Baltic, there has been particular focus on the Bornholm Basin, located between Sweden, Poland and east of the Danish island Bornholm. The importance of this area for Baltic fish stocks, in particular cod and sprat, is related to the unique hydrographic situation in the Baltic and the resulting limitations for the survival of marine, steno-haline fish eggs and larvae.

Reproductive success of the Eastern Baltic cod stock is closely linked to these unique hydrographic conditions (review by Köster *et al.* 2017), which are restricting the main spawning grounds to deeper areas, i.e. the Bornholm Basin (BB) just east of Bornholm as well as the Gdansk Deep (GD) and the Gotland Basin (GB) further east. However, due to oxygen deficiencies in the GD and GB in recent decades, successful spawning of Baltic cod is largely restricted to the Bornholm Basin in recent years.

Presently, Eastern Baltic cod is spawning from approx. March to November, which is the longest reported spawning period of any cod stock. This extremely protracted spawning season can be interpreted as a risk-spreading strategy to cope with the highly variable environmental conditions in the Baltic and the related inter-annual as well as seasonal differences in the survival chances of eggs and larvae.

1.7.2 General information about the present time series of Baltic Ichthyoplankton Surveys (BIS)

The present time series of Baltic Ichthyoplankton Surveys (BIS) was initiated in 1986 by the "Institut für Meereskunde" (IfM, Institute of Marine Sciences, now GEOMAR) in Kiel, Germany and has been running ever since. The extremely protracted spawning season of Eastern Baltic cod makes it necessary to conduct several surveys throughout the year in order to obtain a reliable picture of the seasonal egg production and larval abundances. As this requires considerable vessel time, personnel and resources, several institutes joined forces to cover the spawning season with several surveys per year.

Presently, the following partners are involved in the BIS:

1. DTU Aqua – National Institute of Aquatic Resources, Kgs. Lyngby, Denmark
2. NMFRI – National Marine Fisheries Research Institute, Gdynia, Poland
3. TI-OF – Thünen Institute of Baltic Sea Fisheries, Rostock, Germany
4. GEOMAR – Helmholtz Centre for Ocean Research Kiel, Germany
5. IMF – Institute of Marine Ecosystem and Fishery Science, Hamburg University, Germany

6. BIOR – Institute of Food safety, Animal health and Environment, Riga, Latvia

The time-series of individual BIS surveys by month is shown in Figure 1.26. In the earlier part of the time-series the seasonal coverage is somewhat variable, as the surveys relied largely on funding via running research projects as well as partly on national funding sources. Nevertheless, it was possible to maintain a continuous survey time-series since 1986. In the most recent period since 2008 the seasonal coverage has been very good, with all years covered by 7 to 9 surveys, except for 2020 when only 6 surveys could be conducted due to the Covid-19 pandemic. During this recent period the surveys were usually conducted in March, April, May, June, July and/or August and November, in some years even with 2 surveys in August (early and late) as well as some years with additional surveys in September.

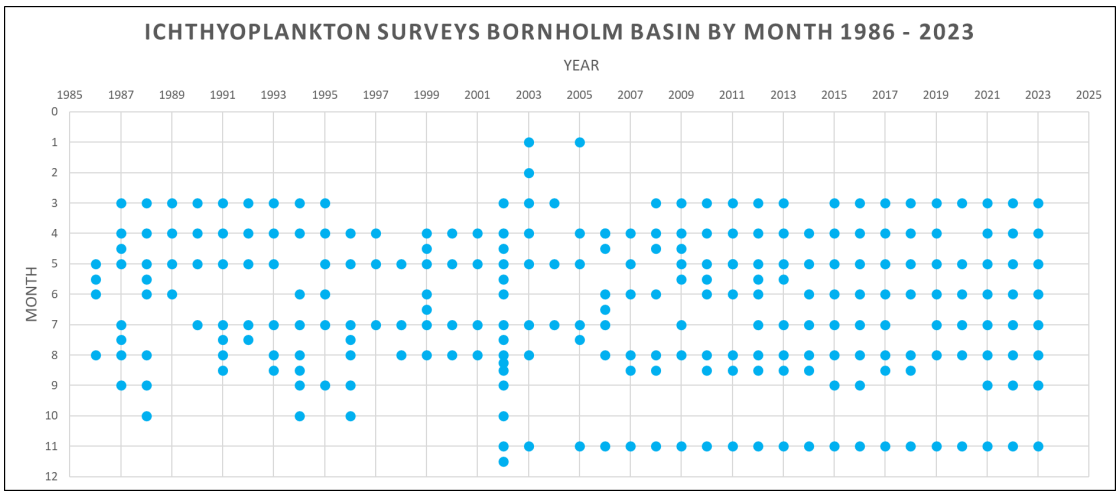

Figure 1.26 Time series of individual BIS surveys by years and months.

As mentioned above, oxygen conditions in the eastern spawning grounds (GD and GB) have deteriorated over the past decades and spawning is therefore largely restricted to the Bornholm Basin. Thus, the present BIS are focusing on the Bornholm Basin. However, some additional information about egg and larval abundances in the GD and GB is also collected every year, in order to detect potential future changes in the utilization of these spawning grounds.

In the beginning of the survey series from 1986 - 1989, only the central BB was covered by a station grid consisting of 20 stations, which was extended to 30 stations from 1990 - 1993. Since 1994, the standard station grid is consisting of 45 stations (Figure 1.27). On some cruises additional stations are covered, e.g. in the Slupsk Furrow or at the basin edges.

On each station ichthyoplankton is sampled with a Bongo net (Ø 60 cm, nets length 320 cm, mesh sizes 335 and 500 µm). The gear is further equipped with a V-fin depressor, a depth sensor and flowmeters. On most surveys, an additional Baby-Bongo net (Ø 20 cm, net length 200 cm, mesh size 150 µm) is attached above the Bongo net in order to collect additional samples of smaller zooplankton size fractions. The gear is deployed at 3 knots ship speed in a double-oblique haul from the surface to 3 m above the sea floor, measured from the lower edge of the Bongo ring. Samples are preserved in 4% formaldehyde-sea water solution for later analysis on land. In addition, profiles of the ambient hydrographic conditions are obtained by CTD casts. Furthermore, adult cod are sampled on selected cruises by trawl fishery to obtain information on fecundity, sex ratios and maturity ogives which are needed for egg production methods and stock biomass estimates (see also next section “Utilization of BIS results in research and stock assessment”).

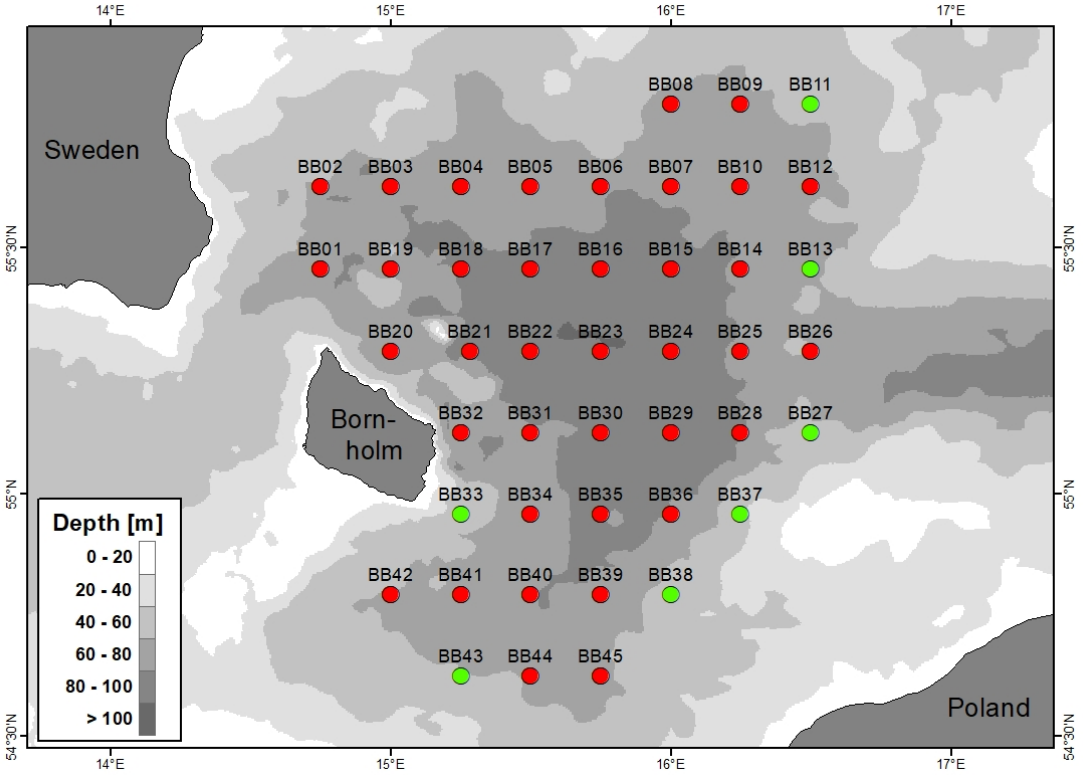

Figure 1.27 The present BIS standard station grid in the Bornholm Basin, consisting of 45 stations. The seven stations shallower than 60 m (green symbols) are excluded from the calculations of average egg abundances used in the AEPM and DEPM.

1.7.3 Utilization of BIS results in research and stock assessment

The BIS surveys have been used for a multitude of scientific research purposes in various projects, including studies on ichthyoplankton ecology and the recruitment dynamics of Baltic cod and sprat. Besides, SSB estimates based on egg production methods for Baltic cod and sprat have been developed, but despite providing promising results these methods had previously not been implemented into the stock assessment.

However, due to increasing issues with the stock assessment of Eastern Baltic cod in the late 2000s and early 2010s, the ideas of fishery independent stock biomass estimates based on egg production have been revived and were implemented in the assessment of Eastern Baltic cod since the benchmark assessment in 2019. Thus, the BIS is now providing input data for annual (AEPM) and daily (DEPM) egg production methods, which are used to provide a time-series of Eastern Baltic cod stock biomass estimates (1986 - present) to WGBFAS.

Besides, the BIS is providing a recruitment index to WGBFAS, based on average larval abundances during the summer months (June - August, time-series 1987 - present). This recruitment index provides an early indication of year-class strength, while the BITS bottom trawl surveys are not catching the new incoming year-classes representatively until age 2. Both the egg-based stock estimates and the larvae index are used as relative trends in stock dynamics to tune the assessment models.

1.7.4 The Baltic Ichthyoplankton Surveys in 2023

Throughout the 2023 spawning season of Eastern Baltic cod, a total of 8 individual BIS surveys were conducted in March, April, May, June, July, August, September and November (see Table 1.6 for details). On most of the surveys the complete standard grid consisting of 45 stations was conducted. Due to rough weather and resulting time constraints, 1 and 2 stations could not be conducted on the surveys in March & November, respectively. However, these were shallower stations at the edges of the Bornholm Basin, which usually do not yield very high egg abundances. In contrast, only 27 of 45 planned stations could be conducted on the survey in July, also due to severe weather conditions. Unfortunately, many of the stations that could not be conducted are located in the central area of the BB, i.e. in the main egg distribution area. Thus, this survey did unfortunately not provide a reliable egg abundance estimate. In total, 339 standard stations were sampled on the 8 individual cruises in 2023. Furthermore, several additional stations outside the standard grid were sampled on some of the surveys. The sample analyses were still ongoing at the time of WGSINS 2023, but the preliminary data suggest similarly low egg and larvae abundances as in recent years. The final data will be collated and the time-series of stock biomass estimates and larvae indices will be provided to WGBFAS in spring 2024.

It is noteworthy that high numbers of the invasive ctenophore *Mnemiopsis leidyi* were found on many of the surveys and in particular on the survey in November, which yielded approximately 10 times as many ctenophores as the long-term average (since 2008) on the November cruises.

Table 1.6 Overview of individual BIS surveys conducted in 2023.

Institute	Ship	Cruise Nr	Year	Month	n standard stations conducted	Cruise dates
DTU Aqua	DANA	DANA 02/2023 (BITS 1)	2023	3	44	March 06 - 24
GEOMAR	ALKOR	AL 592	2023	4	45	April 15 - 27
GEOMAR	ALKOR	AL 594	2023	5	45	May 13 - 28
NMFRI & DTU Aqua	BALTICA	Baltica June 2023	2023	6	45	June 20 - July 01
IMF Hamburg	ALKOR	AL 598	2023	7	27	July 27 - August 06
NMFRI	BALTICA	Baltica August 2023	2023	8	45	August 18 - 24
GEOMAR	ALKOR	AL 601	2023	9	45	August 30 - September 10
DTU Aqua	DANA	DANA 06/2023 (BITS 2)	2023	11	43	November 06 - 24

1.7.5 Planning for the 2024 Baltic Ichthyoplankton Surveys

For the 2024 spawning season of Eastern Baltic cod, a total of 7 individual BIS surveys are planned in March, April, May, June, August (2 surveys) and November. On each of these surveys, it is planned to cover the 45 standard grid stations, amounting to a total of 315 planned stations for 2024. See Table 1.7 for details.

Table 1.7 Overview of individual BIS surveys planned for 2024.

Institute	Ship	Cruise Nr	Year	Month	n standard stations planned	Cruise dates (preliminary)
DTU Aqua	DANA	DANA 02/2024 (BITS 1)	2024	3	45	March 05 - 23
GEOMAR	ALKOR	AL 610	2024	4	45	April 04 - 16
Thünen (TI-OSF)	WH III	WH 478	2024	5	45	May 13 - 26
NMFRI & DTU Aqua	BALTICA	Baltica June 2024	2024	6	45	June 19 - 30
NMFRI	BALTICA	Baltica August 2024	2024	8	45	August 16 - 27
GEOMAR	ALKOR	AL 618	2024	8	45	August 18 - 29
DTU Aqua	DANA	DANA 06/2023 (BITS 2)	2024	11	45	November 04 - 22

2 Pilot surveys & Additional work on existing surveys

2.1 A pilot survey on the feasibility of establishing a sprat recruitment index based on larval sampling during Q3 IBTS surveys

Sprat is a short-lived species, and the sprat stock in the North Sea is dominated by young fish. Thus, the size of the stock is to a large degree driven by the recruiting year class, and catches are mainly composed of 1-year old fish (up to 80%). Sprat is also an important forage fish and represents a major food source for many other fish species as well as sea birds and mammals. It is therefore a highly relevant species in multispecies and ecosystem approaches to fisheries management. An analytical assessment for sprat was established some years ago, however the availability & quality of data for the assessment are relatively poor and the assessment of and advice for the North Sea sprat stock needs to be improved. There is presently no information available on young-of-the-year (0-group) sprat for possible use in short-term forecasts or for use in the stock assessment model. However, such information could potentially be very useful, in particular because sprat is a short-lived species that matures early.

The aim of the present study is - by conducting a series of pilot surveys - to evaluate the feasibility of establishing a sprat recruitment index based on larval sampling during night-time on the Q3 IBTS surveys and to contribute generally to a better understanding of the biology, ecology and distribution of the North Sea sprat stock. Thus, the basic idea is to follow similar procedures as the MIK herring larvae surveys during the Q1 IBTS. These surveys are targeting relatively large larvae (2 to 3 cm) and the abundance of these has shown to relate to later recruitment to the stock, thus providing a recruitment index for autumn spawning herring in the North Sea.

By the time of WGSINS 2023, a total of six pilot surveys had been conducted in July/August 2018, 2019 & 2020 and in August/September 2021, 2022 & 2023 targeting sprat larvae with a MIK net. The surveys were conducted by DTU Aqua, Denmark, in 2018 and 2019 in the framework of the project "BEBRIS - Maintaining a sustainable sprat fishery in the North Sea" and in 2020 and 2021 in the follow-up project "PELA – Pelagic species". Sampling was conducted during nighttime on the Q3 IBTS. Besides, the Thünen Institute of Sea Fisheries in Bremerhaven, Germany contributed to the sampling in 2020 and 2021.

During the first 4 years, it became clear that a number of prerequisites for establishing a recruitment index were fulfilled, e.g. that sprat larvae are present in the survey area at the time of the survey and can be caught representatively, spawning activity of sprat is finished before the time of the survey and the MIK sampling can effectively be incorporated into the standard routines of the Q3 IBTS. However, catchability tests between daylight and nighttime have shown that sprat larvae are only caught representatively at night, which is limiting the available time for sampling to approximately 7-8 hours per night. Furthermore, while the main distribution area of sprat larvae seems to be covered by the Danish Q3 IBTS, a better spatial coverage would be desirable. Based on the promising preliminary results from these first 4 years, DTU Aqua decided to continue the pilot survey in 2022 & 2023.

Table 2.1 provides an overview of the sampled stations in the first 6 years of pilot surveys. In 2018 and 2019, 71 and 66 valid standard hauls (plus several additional hauls for gear tests etc.) were conducted, respectively. In 2020, a total of 128 hauls was conducted (68 by Denmark and 60 by Germany). In 2021, a total of 89 hauls was conducted on a joint Danish-German survey. In

2022 & 2023, a total of 63 & 70 hauls were conducted by Denmark, respectively. Figure 2.1 shows a map of the MIK sampling stations during the 2023 Q3 IBTS.

In addition, Marine Scotland Science also conducted MIK sampling during their Q3 IBTS in 2021 on 51 stations and in 2023 on 17 stations (Figure 2.2). Preliminary results from these surveys showed that some sprat larvae do also occur in the Scottish survey area (i.e. in the area from 54°N to 61°N). However, these results are not yet included in the further analyses of larval abundance and distribution.

Table 2.1 Overview of MIK sampling stations conducted during the Q3 IBTS

Year	Denmark	Germany	TOTAL
2018	71	-	71
2019	66	-	66
2020	68	60	128
2021	89 (joint DK/GE survey)		89
2022	63	-	63
2023	70	-	70

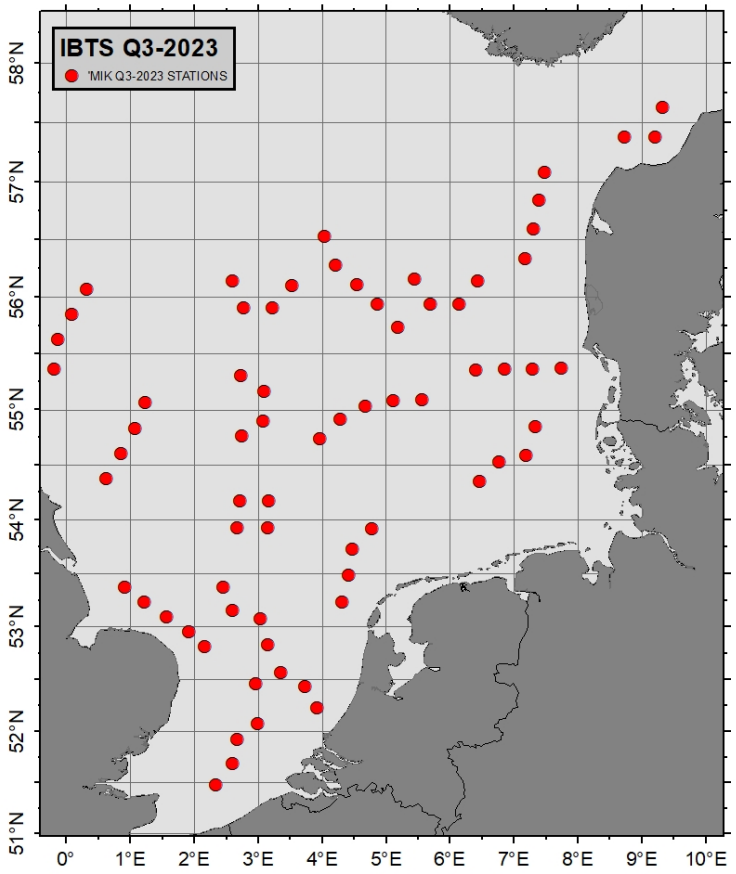

Figure 2.1 MIK sampling stations during the Danish Q3 IBTS in 2023.

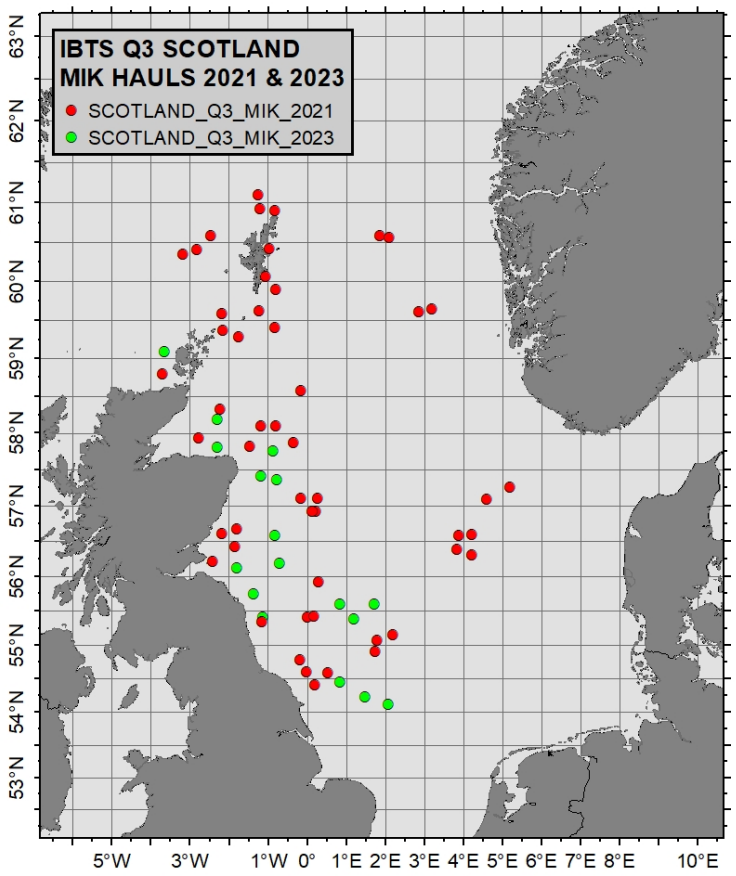

Figure 2.2 MIK sampling stations during the Scottish Q3 IBTS in 2021 & 2023.

The gear in use during the pilot surveys is a MIK net with a ring of two meter in diameter and a mesh size of 1.6 mm. In addition, a small MIKeyM net (20 cm Ø, 500 µm mesh size) was attached to the MIK ring on the Danish surveys in 2018 - 2020 and 2022. This was done to test if there still are eggs and/or very small larvae in the area during the time of the Q3 IBTS surveys, which would indicate that the seasonal spawning activity has not finished yet. The gear was equipped with a depth sensor and was deployed in a double-oblique haul from the surface to 5 meter above the sea-floor (measured from the lower end of the MIK ring). Fishing speed was 3 knots through the water, and the wire was paid out at a speed of 25 meters per minute (= 0.4 ms-1) and retrieved at 15 meters per minute (= 0.25 ms-1). Both the MIK and the MIKeyM were equipped with flow-meters to record the volume of filtered water.

With very few exceptions, clupeid larvae were found on all sampling stations in the 6 years investigated, and abundances were generally relatively high, with many stations yielding several hundreds of larvae. However, in all years the clupeid larvae not only contained sprat but also sardine larvae in high abundances. A similar, recurring pattern in the spatial distribution of sprat and sardine larvae could be observed in all 6 years, with sprat larvae mainly occurring in the northern part of the study area while sardine larvae were most abundant in the south. This shows that careful identification procedures to species level are mandatory. A total of 7405 sprat larvae were caught in 2023, which is close to the average of 8584 in the six years investigated so far. The MIKeyM samples did not suggest any catches of sprat eggs, indicating that sprat spawning activity had been finished and larvae had hatched well before the time of the surveys.

The larvae had a broad size range from approx. 6 mm to juvenile fish of 4 - 5 cm with very similar size frequency distributions for the two species sprat and sardine, but the majority of larvae were in a size range between 12 and 20 mm.

The results from 6 years of pilot surveys that are available so far illustrate that this kind of larvae survey during nighttime of the Q3 IBTS has the potential to provide larval abundance estimates and potentially a recruitment index for North Sea sprat. However, it will still require further analyses to make a final judgement if the larvae survey can provide an early recruitment index that can be used for assessment purposes.

DTU Aqua has applied for a follow-up project to the previous "BEBRIS" and "PELA" projects in order to conduct these further analyses, with the aim to present results at the upcoming benchmark assessment for North Sea sprat (presently planned for early 2025).

If a recruitment index can be established, additional surveys will be necessary to provide further yearly observations and more data for the modelling of recruitment patterns. Therefore - and based on the promising results from the first 6 years - DTU Aqua is planning to continue the pilot surveys in 2024. However, a better area coverage than obtainable by the Danish survey with RV DANA alone would be advisable, and other nations participating in the Q3 IBTS are encouraged to contribute to these pilot surveys.

It is noteworthy that in addition to sprat and sardine, a number of larvae of other fish species were caught in the MIK. The more abundant species were mackerel, horse mackerel, sandeel, gurnards and lemon sole, scaldfish and other flatfishes, as well as several non-commercial species, e.g. gobies, crystal goby, rocklings, pipefish, dragonets and greater weever. In addition, a limited number of larger gadoid larvae and/or pelagic juveniles were caught. Concerning mackerel larvae, there was a tendency of higher catches in the northern part of the sampling area, whereas horse mackerel dominated in the southern part. No dedicated funding is presently available to investigate these other species in detail. However, numbers of larvae of other species from the 2018 and 2019 surveys and partly from the 2020 survey were analyzed in the framework of student theses.

On the 2023 survey a number of sea horses were caught in the southern parts of the survey area, both adults (n = 10) and juveniles (n = 6). This was the first time that sea horses were observed on this survey (except for a single specimen in 2022 which however was dead and in rather poor condition).

2.2 Investigations on recently hatched sandeel larvae in MIKeyM samples collected during the Q1 MIK-IBTS surveys

Several sandeel species are found in the North Sea, with Raitt's sandeel (*Ammodytes marinus*) being by far the most common. Being a major prey for predatory fish, seabirds and mammals, this species is one of the most important forage fish in the North Sea and is also supporting one of the largest single species fisheries in that area. Due to its high ecological and economical importance, a relatively large body of research exists about the species, covering various aspects. However, there is only limited knowledge about the spawning ecology, which may be due to the unique life cycle. From late summer to autumn, the adults and newly recruited juveniles are burying into the sediment where they are overwintering for several months, utilizing specific areas with suitable sediment. Spawning is also taking place in these areas during winter, when the adults are briefly leaving the sediment to deposit demersal eggs on or in the sediment. Thus,

the eggs are more or less impossible to sample, and knowledge about the occurrence and intensity of spawning activity in the different sandeel areas is largely lacking.

The project PELA, which was conducted by DTU Aqua from 2019 - 2022, was aiming to close this knowledge gap by mapping the spatial distribution and abundance of recently hatched larvae as an indicator for spawning activity. It was investigated which of the adult burying areas are actually used for spawning, if the area utilization is consistent between years or if there are inter-annual differences, and if there are differences in larval abundance between years.

The analyses were making use of samples collected with a so called "MIKeyM net", a small ring net with a diameter of 20 cm and a mesh size of 335 µm, which is attached to the larger MIK ring on the annual herring larvae surveys which are conducted at nighttime during the Q1 IBTS. The use of this additional MIKeyM net was introduced some years ago by ICES WGEGGS2, with the aim to obtain information on the occurrence and distribution of cod and plaice eggs. However, it was noticed that the samples also contained very small sandeel larvae, which gave rise to the present study.

The PELA project analyzed MIKeyM samples for a 6-year period from 2015 - 2020, which includes years with contrasting recruitment (2015 and 2017 very poor, 2016 exceptionally high, 2019 very good recruitment). The analyses included all available samples from Denmark, Germany, Norway, the Netherlands and France, as these nations are covering the main sandeel habitats during their Q1 IBTS. Larvae of sandeel and other fish species were sorted from the samples, counted, and sandeel larvae were scanned and length measurements conducted with an image analysis system. An exception are the French samples, which are anyhow regularly analyzed by Ifremer via zooscan or zoocam, and for which the sandeel larvae data were provided to DTU Aqua.

Results show that the majority of sandeel larvae in the samples are only about 5 to 6 mm. As the hatch size of *A. marinus* is approx. 5.5 mm, the sampled larvae can be considered to have hatched very recently, i.e. they have not drifted very far and should indeed provide an indication for spawning areas. This is also supported by the spatial distribution of larvae, which only show considerable larval abundances in the immediate vicinity of the known sandeel burying areas. In addition to maps showing the actual larval abundances, hot spots of larval occurrence were also analyzed with a spatial GAM model (see WGSINS reports 2021 & 2022). These analyses indicate spatial differences in the utilization of burying areas, as certain areas are frequently used for spawning while other areas are apparently not regularly used. High larval abundances were usually found in the Dogger Bank area as well as in the Horns Reef area west of Denmark, indicating that these are major spawning areas. In contrast, in the central area at "Elbow Spit" no or at least only few larvae were found, which indicates that this is an area of minor importance for spawning. In addition, the data show clear differences in larval abundance between years.

As the burying areas are located in different management areas, another aim was to gather more information if sandeel in a specific management area are also reproducing and recruiting in that area, or if they are migrating from other management areas. This was supported by hydrodynamic modelling, i.e. backward and forward projections of larval drift routes, starting at their their catch positions, were conducted to identify hatching and settling areas.

In combination with information from other investigations (e.g. genetic analyses), these results were utilized in the recent Benchmark Workshop on Sandeel (*Ammodytes spp.*) in 2022 (WKSANDEEL) to delineate the stock structure of sandeel in the North Sea and to review and re-define the borders of the sandeel management areas.

Project outcomes are summarized in a working document, and it is planned to elaborate on this and publish the results in a scientific journal. This publication may also draw on information from dredge surveys aiming at the buried adults and juveniles, which may allow to investigate

if the sandeel are utilizing different areas for overwintering, spawning and foraging, and how they are moving between different areas throughout the year. In addition, data on sediment samples from the dredge surveys could be used to analyze if the sandeel prefer different sediment types for overwintering and for spawning.

2.3 Marine Litter sampling during the North Sea Midwater Ring Net survey (Q1 MIK-IBTS)

Marine litter is collected from standard MIK samples taken during the Q1 IBTS (Denmark since 2014, all other nations since 2017). The samples collected up to 2020 have been analyzed in the project MARLINS (Marine Litter in the water column of the North Sea) coordinated by DTU Aqua and funded by the Danish VELUX Foundation.

In addition, samples from Dutch Downs MIK surveys and Danish Q3 MIK pilot surveys were analyzed in the project. The following samples were analyzed and results compiled in a database in the MARLINS project:

(1) Q1 MIK Denmark 2014 - 2016

(2) Q1 MIK All nations 2017 - 2020

(3) Dutch Downs MIK 2018 & 2019

(4) Danish Q3 sprat pilot surveys 2018 - 2020

The final database includes data from a total of 2988 sampling stations and detailed information for 2356 individual litter items.

For further details, it is referred to previous WGSINS reports, the final MARLINS report and a presentation at the ICES ASC 2021 (Theme Session J: "Advances and challenges in marine litter pollution"). It is further planned to publish results in a relevant scientific journal, e.g. Science of the Total Environment or Marine Pollution Bulletin.

There is no additional funding available to continue the detailed MIK litter analyses from 2021 onwards. However, in contrast to many other studies on marine litter which are usually based on either beach surveys, bottom trawling or sampling in surface waters, the MIK net is sampling the entire water column down to 100 m, filtering large volumes of water. Besides, the MIK survey covers a large area and the amount of litter can be quantified as flowmeter data are available anyhow, whereas many other marine litter studies are spatially restricted and qualitative or semi-quantitative. Furthermore, the sampling of marine litter from MIK samples does not require any additional vessel time. Thus, the MIK survey can provide unique and valuable data on the occurrence, distribution and abundance of free-floating marine litter in the entire North Sea area, as well as indications of potential sources and transport pathways. Therefore, WGSINS agreed that it is worthwhile to continue the MIK litter sampling in the future, and to investigate options for the future funding of the MIK litter analyses.

2.4 Holistic approach to the ichthyoplankton surveys in the North Sea and adjacent waters. Can we define common themes/cross overs between the different surveys?

Currently there are a number of surveys sampling ichthyoplankton in each of the Greater North Sea (including a small part of the Celtic Sea region), Irish Sea, Baltic Sea (e.g. the Bornholm Basin) and to the west of the British Isles. The general location and timing of a selection of these surveys are shown in Figure 2.3. Each of these surveys generally has one or two target species and whilst other eggs and larvae are also sampled, currently these non-target species are often not reported, identified, or enumerated. A summary of the target species and the eggs and larvae routinely identified and enumerated is given in Table 2.2.

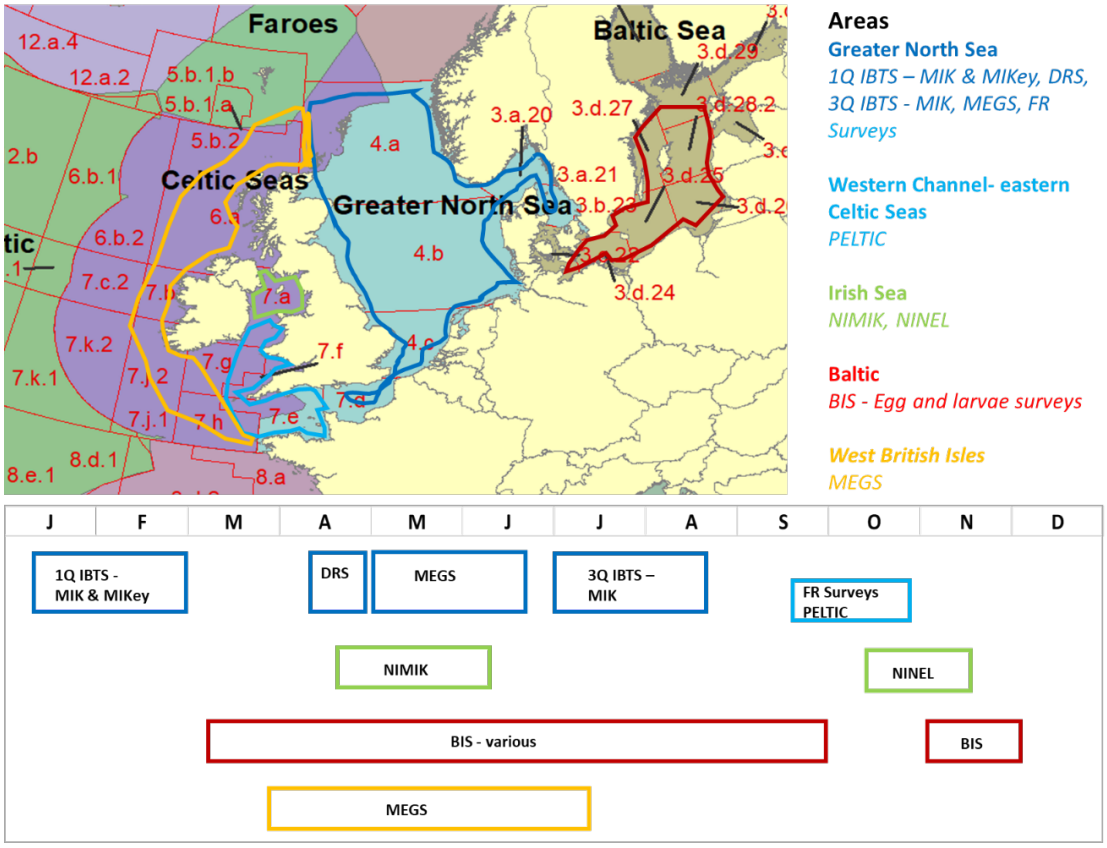

Figure 2.3 Current ichthyoplankton surveys in the North Sea and adjacent areas. Upper panel; Geographic location of surveys. Lower panel; Annual survey time slots. Note that the MEGS to the west of the British Isles is triennial and there are other surveys which are not shown here.

Table 2.2 Target species and ichthyoplankton identified and enumerated in the surveys given in Figure 2.3. 1Q IBTS MIK – 1st Quarter IBTS MIK survey; 1Q IBTS MIKeyM– 1st Quarter IBTS Survey MIKeyM sampling; DRS – Downs Recruitment Survey (MIK); MEGS – North Sea and to the West of the British Isles Mackerel Egg Survey; 3Q IBTS MIK – 3rd Quarter IBTS MIK; FR Surveys – French ichthyoplankton surveys in the English Channel; PELTIC – Acoustic survey in the western Channel and Celtic Sea; ISMIK – Irish Sea MIK; ISHLS – Irish Sea Herring larvae survey; BIS – Bornholm Basin ichthyoplankton surveys.

Survey	Target species	Others identified or enumerated	Non-identified
1Q IBTS MIK	Herring	Sprat, sardine, lemon sole	Various
1Q IBTS MIKeyM	Cod, plaice, sandeel	Various eggs	Various eggs
DRS	Herring	Sprat, sardine	Various larvae
MEGS (NS & Western)	Mackerel, Horse mackerel		Various eggs and larvae
3Q IBTS MIK	Sprat	Sardine, mackerel	Various larvae
FR Surveys	Sardine		Various eggs
PELTIC	Sprat, sardine		Various larvae
NIMIK	Cod, haddock	Majority of larvae	
NINEL	Herring		
BIS	Cod, sprat	Herring larvae, various eggs & larvae	

These surveys, when considered together, could provide temporal information on the ichthyoplankton in these regional seas, and if considered together with e.g. the hydrography and/or lower trophic levels e.g. chlorophyll-a or zooplankton, contribute to an ecosystem level assessment of the area. In addition, these data could provide additional ecological data on the dynamics of the early life history of a number of commercially important fish species. This could also include comparisons or investigations of synergies between areas and/or putative stocks.

Besides input to assessments, there is the question, what else can the surveys be used for? What products and information could be delivered? Obvious examples are spatial distribution and ecology of non-target species. Variability in spawning time and hatching areas. In regard to species of interest there is a long list of potential species which include: herring, cod, lemon sole, sprat, haddock, witch, sardine, plaice, ling, anchovy, sole, mackerel and hake.

Using one species as an example, sprat, there is potentially data on larvae distributions from the Celtic Sea, up into the Irish Sea, through the English Channel and into the North Sea. Similarly, with sardine there are larvae data from the Celtic Sea eastward into the North Sea. In the latter case there is a distribution and abundance increase in both adults and larvae over time from the west to the east. In regard to fisheries, currently a fishery and assessment of stock size takes place in the south and west (Biscay and Subarea 7) but as yet does not in the east (Subarea 4).

This section has only considered the on-going vessel-based surveys, however, there are also a number of other data sources that could also be considered within this framework. Of particular interest here are the fixed stations such as the Marine Biological Association station L4 (English Channel;Western Channel Observatory), Helgoland Roads sampling station (Malzahn and Boersma 2007) and the Newcastle sampling station (Dove Marine Laboratory - School of Natural and Environmental Sciences - Newcastle University (ncl.ac.uk)) (all of which have long time-series). There is a possibility there are additional data, at least on small juveniles from coastal

power stations that retain fish on their cooling water intake screens. The availability of these data needs to be investigated.

The Working Group will continue to consider the potential 'added' value which can be gleaned from these surveys and how additional data, e.g. by considering combinations of surveys, can be used to inform on pertinent uncertainties in the assessment of specific stocks in the ICES area.

3 Data handling and discussions on various ToRs and other topics

3.1 ICES Eggs and Larvae database

Most surveys under the the WGSINS umbrella utilize the ICES egg and Larvae Database (ELDB: https://www.ices.dk/data/data-portals/Pages/Eggs-and-larvae.aspx) for the storage of Larvae and Haul Data. Each nation is responsible for the submission and quality checking of their own data. In the case of the North Sea MIK (Midwater Ring Net) survey, the calculation of the MIK index is also being implemented via the ICES TAF environment.

At WGSINS 2023 representatives from the ICES Data Centre presented updates in the development of the ELDB since the previous meeting. These largely centred around the creation of the Working Group for Egg & Larvae and Fecundity & Atresia Database Governance (WGELFADG) in 2023.

WGELFADG will operate under DSTSG and WGALES, serving as a go-between for the multiple working groups utilizing the ELDB and the ICES Data Centre, and will discuss and come to resolutions on requests and queries generated by these groups. The chair of WGELFADG presented the group's TORs and made a request for membership from WGSINS participants with relevant expertise, or who are users of the database. The Governance group will also advise on the development of the new Fecundity and Atresia Database (FADB). Representatives from the ICES Data Centre presented an introduction to the FADB, its present status and the plan for its implementation. The FADB is currently undergoing testing before being opened for data upload from the 1st January 2024. Members of WGSINS who have an interest in Fecundity, Batch Fecundity, and Atresia analysis were asked to act as testers for the database and provide feedback during this phase.

Contributions from WGSINS members were requested by WGELFADG in order to update the ELDB website text and Database Fact Sheets in 2024. These included updated descriptions of the MIK survey and the Gulf of Riga Larvae survey. The continued participation of WGSINS members in updating the information related to their surveys in ELDB supporting documents in future is encouraged.

A number of suggestions for the ELDB were discussed during the meeting. Firstly, some countries faced issues when uploading data as they carried out multiple surveys using the same country code, vessel ID, and survey type during one year, in some cases during one period. The current key identifiers treat these datasets as the same, and will automatically seek to replace one with the other when uploading to the database. A discussion around potential additional key identifiers was held, and it was determined that rather than introduce a new identifier the list of survey codes should instead be expanded to include multiple codes for each period of a given survey per year. Secondly, during key periods such as the run up to Assessment Group meetings where indices are being calculated the overnight delay in updating the ELDB is problematic when changes need to be made and calculations re-run to tight deadlines. WGSINS participants agreed that a reduction in the update time, ideally one allowing for immediate updating of the database, should be sought. As this would be much more resource intensive for the ICES Data Centre, it was decided to only request this change during these pre-agreed key periods. A recommendation outlining both suggestions was submitted to the ICES Data Centre, WGELFADG, and related Survey Groups.

3.2 Additional Data products

Apart from the data needed for the original survey objectives (e.g., calculating indices for assessment purposes), Ichthyoplankton surveys can provide additional information on e.g. the spatial and temporal distribution of other fish eggs and larvae, co-occurring in the catches. For some of these species, this will be the only source of information about their planktonic phase, because they are not of high commercial value and thus not part of any dedicated survey program.

Additional sampling and sorting of fish larvae (other than herring) was continued in the MIK surveys. Analyses of other fish larvae species of the Q1 MIK sampling is requested for at least sardine, lemon sole and eel, while details on sprat, sardine, mackerel, horse mackerel, lemon sole and red mullet larvae are wanted from the Q3 MIK sampling. The Q1 MIK 2023 sampling results were imported into the ICES eggs and larvae database (as far as available). The collection of material for species identification workshops will be continued.

Additional data products are also available with regards to the marine litter monitoring in some of the MIK surveys and on the distribution of jellyfish and other planktonic species in the northern Irish Sea (NI-MIK). Besides, information on jellyfish is available for some of the Danish Q1 and Q3 MIK surveys in the North Sea and is partly already published (Gawinski et al. 2019, Køhler et al. 2022). Likewise, some of the BIS surveys in the Baltic provide information on jellyfish, which has also resulted in several publications (e.g. Huwer et al. 2008, Schaber et al. 2011a,b, Jaspers et al. 2018a,b).

Additional data products from these surveys can also support the implementation of an ecosystem approach to fisheries management through the provision of data on important pelagic components of marine ecosystems (e.g. gelatinous zooplankton, macro plankton). These components are not sampled effectively by traditional fishery survey methods and therefore are underrepresented in many existing survey datasets. Data collected by ichthyoplankton surveys on the distribution and abundance of these ecosystem components can be used to parameterize food web models and support research developing our understanding of the pelagic habitat.

Session on added value of ichthyoplankton surveys

To highlight the potential of ichthyoplankton surveys to provide additional data products, several presentations at the 2023 WGSINS meeting were grouped into a dedicated "Session on added value of ichthyoplankton surveys: Possibilities to supply additional ecosystem data". Various different topics were presented to the participants.

Daniel Oesterwind (Thünen Institute, present chair of WGCEPH) shared some thoughts how existing ichthyoplankton surveys may improve our knowledge about cephalopods, in particular concerning the ecology of early life stages as these are not caught during standard trawl surveys. The abundance and distribution of cephalopod (para)larvae caught in ichthyoplankton surveys could certainly help to widen the knowledge about these early life stages and spawning locations. Questions regarding species community changes as an effect of increasing water temperature as well as extinction and intrusion of species could also be a by-product of WGSINS surveys. All MIK-Q1 and IHLS participants present at WGSINS agreed to collect and provide samples of cephalopods for further analyses.

Some aspects on the additional outputs of the NIMIK net survey were shown by Steven Beggs (AFBI). Available data form meanwhile an impressive time-series including a large number of species and genera. It has been shown that colder years yield higher amounts of Irish Sea cod larvae in the MIK compared to warmer years. Thus, environmental information about Sea

Surface Temperature is now integrated in the Irish Sea fisheries advice. It is work in progress to gather even more species data and to improve the ecosystem modelling.

Steven also presented preliminary results of neuston (micro)plastic sampling. Not all data are fully worked up yet, but the western Irish Sea gyre may serve as a retention area for plastics. Some components like rope filaments are often associated with gyres and fishing grounds.

Hannes Höffle (IMR) presented "Preliminary results from the Ecosystem cruise in the northern North Sea in spring". This cruise was conducted in April / May 2023 and is part of a time series dating back to 2006. The survey samples 20 transects, using a variety of nets and gears, but the focus of the presentation was on Gulf VII data. Clupeid and gadoid larvae were mainly found in the western parts of the survey area, while flatfish larvae were common in the whole area. A simple model for larvae distribution shows impact of water depths and temperature. Most larvae were in the range of a few centimetres, which is quite large for a GULF VII sampler.

Jeroen van der Kooij (CEFAS), a new member of WGSINS, presented the PELTIC surveys, Pelagic Ecosystem Surveys in the Western Channel and Eastern Celtic Sea. The aim of the PELTIC survey is to map and quantify the SPF community in context of its habitat in the western Channel, Bristol Channel and Celtic Sea area. The survey occurs annually in the autumn and has been running since 2012. Acoustic transects (5 frequencies) along with trawl sampling and registration of apex predators are undertaken during daylight hours. During night, ringnet sampling for ichthyo- and meso-zooplankton is undertaken along with Rosette/CTD, water (dissolved oxygen, HPLC, inorganic nutrients, phytoplankton, microzooplankton) and eDNA as well. The acoustic data are currently used as input to stock assessments of Channel sprat (Divisions 7d and e) and SubArea sardine. The principal eggs and larvae encountered in this survey are from Sardine (*Sardina pilchardus*). There is now a time series of abundances of sardine eggs and larvae dating from 2012. In general, the highest densities of both eggs and larvae are found in the vicinity of the Cornish and Devonshire coasts of the western Channel, with both eggs and larvae also occurring to the north of the Cornish peninsular in some years. These distributional data will be further analyzed with the available acoustic data on distribution and abundance of adults and physical data (temperature, fronts etc.) to investigate the causes of variability in abundance (spawning activity) and distribution. A more detailed description of the ichthyoplankton and related data from this survey will be presented in the 2024 WGSINS report. It was discussed that it would be interesting to link the observed increase in sardine catches to the regular observations of sardine larvae from the Q1 and Q3 MIK sampling in the North Sea. Similar links may also be investigated for sprat and anchovy, as larvae of these species are also found in the Q3 MIK sampling.

Carolina Giraldo (IFREMER) gave a presentation on "Plankton from the Channel Ground fish survey (FR-CGFS)". The channel ground fish survey is a demersal survey focusing mainly on gathering data for stock assessment of demersal species. However, some ichthyoplankton samples are collected as well and in particular sardine eggs using a CUFES. Egg samples are analyzed on board using a « ZooCAM » imaging system, such that all egg abundance information is available by the end of the survey. It was discussed that there is a great opportunity to combine samples and data between the PELTIC and CGFS surveys to identify main spawning grounds of sardine.

Bastian Huwer provided "Updates on Sandeel, Sprat & Sardine larvae, Marine litter & Jellyfish from Q1 & Q3 MIK". Most of these topics are described in detail in report section 2 "Pilot surveys & Additional work on existing surveys" (Sprat & Sardine larvae - section 2.1, Sandeel larvae - section 2.2, Marine litter - section 2.3). Investigations on jellyfish are conducted on the Danish Q1 and Q3 MIK surveys in the North Sea and on most of the BIS surveys in the Baltic, which has resulted in a number of publications (e.g. Huwer et al. 2008, Schaber et al. 2011a,b, Jaspers et al. 2018a,b Gawinski et al. 2019, Køhler et al. 2022).

The dedicated "Session on added value of ichthyoplankton surveys" was rounded up by revisiting and elaborating on the idea of a "Holistic approach to ichthyoplankton surveys" which had been introduced by Richard Nash at WGSINS 2022 (for details see section 2.4).

Overview of current and potential new additional data collections

WGSINS ToR g aims to "Assess possibilities for the different ichthyoplankton surveys to supply ecosystem data to support the implementation of an ecosystem approach to fisheries management". The dedicated "Session on added value of ichthyoplankton surveys" showed that a number of additional data collections are already ongoing during the different surveys and suggestions for new additional data collections were discussed as well. However, the types of additional data collections are rather diverse and differ between surveys and institutes, and also some of the applied methodologies differ, e.g. regarding gears, sample treatment and preservation methods. A detailed overview which additional information is collected on which surveys with which methods is presently lacking. Such an overview would help to exploit the potential of the additional data collections more efficiently, e.g. by identifying which information from different surveys can be combined or supplement each other. Therefore, the deliverable of ToR g is to "Provide an overview of current and potential new data collections, in addition to the target species, and their potential uses for ecosystem management".

WGSINS 2023 discussed how the rather comprehensive and diverse information on additional data collections could best be summarized and presented. It was decided to produce one overview table for each of the ichthyoplankton surveys under the WGSINS umbrella. A template for this table was suggested by the WGSINS chair and discussed and developed further by the group. This template will be placed on the WGSINS sharepoint and populated with information for the seven different surveys coordinated by WGSINS during the first half of 2024, in order to obtain a comprehensive overview that can then be reviewed, discussed and edited at WGSINS 2024 and presented in the end-of-term report.

3.3 Species identification

Correct species identification is essential to obtain reliable survey results and indices for use in stock assessments. Most of the surveys coordinated by WGSINS are targeting larvae of different clupeid species, which are co-occurring in the survey areas (herring, sprat and sardine). The correct identification of these species requires specific expertise, including knowledge of certain morphological traits such as the position of the pelvic fins in relation to the pylorus or the number of pre-anal myomeres. Therefore, dedicated larval identification workshops are organized in order to ensure expertise and consistency in species identification. Recent workshops were WKIDCLUP in 2014 (ICES 2014) and WKIDCLUP2 in 2021 (ICES 2022a). Based on the re-assuring results of the most recent workshop identification trials, the potential error caused by misidentification of clupeid larvae can be considered as low or negligible.

Due to the Covid-19 pandemic and related international travel restrictions, WKIDCLUP2 had to be held online. Prior to the workshop, the WebApp SmartDots was adapted to be utilized for ichthyoplankton identification based on images. Overall, the WebApp SmartDots proved to be very useful for holding such larval identification events. However, while the ICES data centre and the SmartDots team provided excellent support to get WKIDCLUP2 established and conducted, it also became apparent during the workshop that there was room for improvements and to adapt SmartDots (which was originally invented for otolith age reading) more specifically for identification workshops on fish eggs and larvae.

Therefore, the new egg and larvae module was recently further developed by the SmartDots team, considering the experiences and advice from the WKIDCLUP2 and WKMACHIS workshops (ICES 2022a,b). Furthermore, several WGSINS members contributed to the testing of the new module and provided feed-back during 2023, prior to the final implementation of the new module. At WGSINS 2023, SmartDots and the new egg and larvae module were presented by one of the chairs of WGSMART, Julie Olivia Davies (DTU Aqua). The final version is now implemented, and an online workshop was held in 2023 to introduce the new module and features of SmartDots to e.g. coordinators of identification workshops and other interested persons.

There was general agreement that the final implementation of the new egg and larvae module is an important step forward, which makes the use of SmartDots even more convenient and user-friendly. While SmartDots can not entirely replace hands-on identification training on actual egg and larvae samples, it provides several important advantages for larval identification workshops. These include the possibility to establish and store image libraries that can be re-utilized at future workshops and the fact that a larger number of interested persons can participate in online workshops, e.g. due to reduced travel costs. In addition to internationally coordinated identification workshops, the egg and larvae module also provides excellent opportunities for in-house training of personnel at the institutes participating in ichthyoplankton surveys.

3.4 Discussions on other topics

Survey manuals

As some of the methodologies used in ichthyoplankton surveys are quite universal, WGSINS had developed an idea to produce a new, combined survey manual which describes several surveys coordinated by WGSINS. A first draft of this manual was planned for May 2023. However, this draft could not be developed as planned, as it turned out in the development process that most of the surveys had many different settings and specific preferences. Thus, the initial idea of an overall manual combining several ichthyoplankton surveys could not be accomplished.

However, two of the surveys, the IHLS and the NINEL, are comparable in their methodologies and will therefore be combined in one manual. So far, the IHLS manual was updated were necessary and the relevant information to include the Northern Irish herring larvae surveys (NINEL) is at hand. The draft should be presented and discussed at an intersessional meeting on future developments of the IHLS, scheduled in April 2024. This should also include further approaches regarding the manuscript.

Specific sections to be considered include (1) Description of sampling gears (Gear photos, Mesh sizes etc.), (2) Sorting procedures (species, measurements, preservation) and (3) ID/ keys reference lists.

The final aim is to publish a combined manual for IHLS and NINEL as ICES TIMES publication.

At WGSINS 2023, it was decided not to include the MIK survey in the planned combined manual, as many of the applied methodologies are rather different than in the IHLS and NINEL surveys, and a specific manual already exists for this survey (SISP 2 - Manual for the Midwater Ring Net sampling during IBTS Q1. Currently on its 3rd edition, published in 2017 https://doi.org/10.17895/ices.pub.7578). The manual is still up to date and working well during the surveys, and an update therefore not needed at present. However, a conversion of the MIK manual from SISP to TIMES format, including a thorough review and update, will be required at some point within the coming years.

Likewise, methodologies used during the North Sea cod and plaice egg surveys (which are actually an addition to the Q1 MIK survey, i.e. an additional, smaller MIKey M net is attached to the larger MIK net) are rather different from IHLS and NINEL, and a separate manual already exists for these surveys as well (SISP 13 - Manual for North Sea cod and plaice egg survey. Currently on its 3rd edition published in 2018 https://doi.org/10.17895/ices.pub.5225). Also in this case an update of the manual is not needed at present, but a conversion from SISP to TIMES format will be required at some point.

WKSIDAC2 - Second Workshop on Stock Identification and Allocation of Catches of Herring to Stocks

The workshop chair Richard Nash presented a summary of the workshop and outcomes that may be of relevance to WGSINS. The Workshop was held 19-23rd June 2023 at ICES Headquarters in Copenhagen. The Workshop concentrated on the genetic techniques and outputs for delineating herring populations. Of interest here is the identification of many herring populations especially in the North Sea and the Skagerrak and Kattegat region. In the area of Division 3a there were quite a few herring populations of Baltic origin. This points to potential problems with determining the population or stock of an induvial herring and to the potential for implementing routine molecular level identification protocols. The extent that this will be necessary for ichthyoplankton surveys is as yet unknown.

General WGSINS business

The information describing the work of WGSINS on the ICES homepage was reviewed, discussed and edited by the group. The new WGSINS description text is now updated on the ICES homepage.

The Survey descriptions and associated Fact sheets about the different ichthyoplankton surveys on the ICES Eggs and Larvae Database (ELDB) webpage were reviewed and discussed. Most descriptions and fact sheets were up to date. However, the description and fact sheet for the North Sea Midwater Ring Net survey (MIK) is missing and needs to be included. This will be done by the survey coordinator primo 2024. In the future, updates and maintenance of the ELDB descriptions and factsheets will be handled by the recently established Working Group for Egg & Larvae and Fecundity & Atresia Database Governance (WGELFADG).

The WGSINS membership information was reviewed and updated, i.e. members that have retired or have not been actively participating for several years were removed from the list and the status of active members was updated.

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Annex 1: List of participants

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Note: In addition, the following six guests participated in the meeting:

Marta Majewska (ICES Scientific officer), Adriana Villamor & Maria Makri (ICES Data Centre), Julie Olivia Davies (DTU Aqua, Chair of WGSMART), Daniel Oesterwind (Thünen Institute for Baltic Sea Fisheries, Chair of WGCEPH), Kelly Chin (Wageningen Marine Research).

Annex 2: Resolutions

2021/FT/EOSG07 The **Working Group on Surveys on Ichthyoplankton in the North Sea and adjacent Seas (WGSINS),** is chaired by Bastian Huwer, Denmark, and will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2022	29 November – 01 December	Belfast, Northern Ireland	Interim report by 7 January 2023 to ACOM/SCICOM	Incoming Chair Bastian Huwer (DK)
Year 2023	28 November – 01 December	Aberdeen, Scotland	Interim report by 1 January 2024 to ACOM/SCICOM	Bastian Huwer (DK)
Year 2024	26 November-29 November	Copenhagen (DTU Aqua)		

ToR descriptors

ToR	Description	Background	Science plan codes	Duration	Expected Deliverables
a	Planning and execution of North Sea and adjacent seas ichthyoplankton surveys used for assessment and management purposes	Ichthyoplankton surveys in the North Sea and adjacent Seas deliver abundance data of early life history stages for fish SSB and/or recruitment for assessment of several fish stocks.	3.1, 3.2,	year 1, 2, 3	Survey Plan
b	Provide quality assurance of the survey indices time series to assessment working groups	Consistency in generation of data is a crucial prerequisite for the use of a time series in the assessment.	3.1, 3.2, 5.2	year 1, 2, 3	
c	Update manuals for ichthyoplankton surveys in the North Sea and adjacent seas	Existing manuals should be updated regularly as new information becomes available	3.1	year 3	Updated Times manuals
d	Provide quality assurance of ichthyoplankton identification, including molecular methods	The accurate identification of ichthyoplankton and the developmental stages is crucial for species specific abundance estimates.	3.1, 3.2	year 1, 2, 3	
e	Standardization of sampling and sample processing procedures	Standards of sampling and sample processing procedures need to be optimized w.r.t. efficiency	3.3	year 1, 2, 3	

f	Prepare data for archiving in the ICES eggs and larvae database	WGSINS data need to be prepared and uploaded to the ICES eggs and larvae database by each institute	3.2	year 1, 2, 3	Updated dataset in the ICES eggs and larvae database
g	Assess possibilities for the different ichthyoplankton surveys to supply ecosystem data to support the implementation of an ecosystem approach to fisheries management	Ichthyoplankton surveys are able to provide additional data than needed for the original survey objectives. The acquisition of additional data has to be assessed.	3.1, 3.3	year 3	Provide an overview of current and potential new data collections, in addition to the target species, and their potential uses for ecosystem management

Summary of the Work Plan

Year 1	Plan and execute the International herring larvae surveys in the North Sea (IHLS), the North Sea Midwater Ring Net survey (MIK), the Downs recruitment survey (DRS), the Northern Irish Northeastern Larvae Survey (NINEL), the Northern Ireland MIK Survey (NI-MIK), the Rügen herring larvae survey (RHLS) and the Baltic Ichthyoplankton Surveys (BIS)
Year 2	Plan and execute the IHLS, the MIK, the DRS, the NINEL, the NI-MIK, the RHLS and the BIS
Year 3	Plan and execute the IHLS, the MIK, the DRS, the NINEL, the NI-MIK, the RHLS and the BIS

Supporting information

Priority	This working group is important for the fisheries advisory process. The different ichthyoplankton surveys in the North Sea and adjacent seas provide important fishery-independent stock and/or recruitment data used in the assessment for herring stocks in the North and Baltic Seas as well as for cod in the Baltic and the Irish Sea, as well as for haddock in the Irish Sea and informs management of whiting in the Irish Sea.
Resource requirements	None.
Participants	The working group is normally attended by 8 – 15 members and guests.
Secretariat facilities	ICES data center
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	HAWG, WGCSE, WGBFAS
Linkages to other committees or groups	EOSG, WGBIOP, IBTSWG, WGALES, WGML, WGZE, DSTSG
Linkages to other organizations	None

Annex 3: Survey Summary Sheets

International Herring Larvae Surveys in the North Sea (IHLS)

Nation:	Vessel:	Dates
Germany	Walther Herwig 3	16 September – 26 September 2022
Netherlands	Tridens 2	19 September – 29 September 2022
Netherlands	Tridens 2	19 December – 23 December 2022
Germany	Walther Herwig 3	04 January – 13 January 2023

Cruise	North Sea IHLS monitor the abundance and distribution of newly hatched herring larvae at the main spawning grounds of autumn spawning herring along the Scottish and English coast in September and on the Downs spawning ground in the English Channel in December and January.
Gear details:	Gulf-type high speed plankton sampler catches are taken during day and night time. Mesh size of the net is 280 microns. The sampler is equipped with a CTD for measurements of actual sampler depth, salinity and temperature profiles as well as internal and external flowmeters determining the filtered water volume. Samples are taken in a V-shape manner, e.g. from the sea surface down to near the seabed (5m above the bottom) and back to the surface.
Notes from survey (e.g. problems, additional work etc.):	Four survey areas could be sampled as scheduled. The survey in the English Channel in January 2023 had to face severe weather problems. Thus only 50% of the planned stations have been sampled. The resulting larvae index for this area is therefore most likely an underestimate. Larvae distribution around the Orkneys was different from previous years, as most larvae were found more easterly than usual. In the Buchan and the central North Sea, newly hatched larvae concentrated in two areas. In all survey areas, herring larvae were less abundant compare to last year. The distribution of larvae in December was unusual in that manner that highest concentration of herring larvae were observed in the inner part of the English Channel, and not in the most westerly area as in other years. The estimated larvae abundance indices could be used in the assessment of North Sea autumn spawning herring.
Number of fish species recorded and notes on any rare species or unusual catches:	In total, 373 plankton samples were taken during the IHLS surveys between September 2022 and January 2023. They contained 48,834 herring larvae.

Stations fished

ICES Divisions	Strat.	Gear	Tows planned	Valid	Add.	Inv.	% stations fished	comments
4a, 4b	N/A	Gulf	261	261	0	0	100 %	Extra hauls taken when abundance was dense.
4c, 7d	N/A	Gulf	141	112	0	0	79 %	Extra hauls taken when abundance was dense.
total	N/A	Gulf	402	373	0	0	93 %	

Strat: strata; Add: Additional tows; inv: Invalid

North Sea Midwater Ring Net survey (MIK)

Nation:	Vessel:	Dates (planned according to Q1 IBTS cruise program)	Comment
Denmark	Dana	25-01 to 12-02	
France	Thalassa II	24-01 to 13-02	
Germany	Walther Herwig III	20-01 to 20-02	Technical & weather issues – approx. 11 survey days lost
Netherlands	Tridens 2	23-01 to 22-02	
Norway	GO Sars	04-02 to 27-02	
Scotland	Scotia	22-01 to 10-02	Technical & Covid-19 issues – approx. 7 survey days lost
Sweden	Svea	25-01 to 07-02	

Cruise	The North Sea Midwater Ring Net survey (MIK) aims to conduct plankton net tows to determine the abundance of late North Sea herring larvae, which is used to provide a recruitment index, the so-called "0-ringer index", for the stock assessment of North Sea herring. Work is carried out at night-time during the Q1 IBTS in the North Sea.
Gear details:	Night-time plankton catches are carried out with the standard midwater ring net (MIK), a large ring net with a diameter of 2 meters and a mesh size of 1600 µm.
Notes from survey (e.g. problems, additional work etc.):	The 2023 MIK survey was faced with some minor challenges due to bad weather conditions. A Covid-19 outbreak & technical/mechanical issues onboard of one vessel as well as technical/mechanical issues on another vessel resulted in loss of survey days and thus also in a reduction of the number of conducted MIK hauls. A total of 716 MIK hauls were planned according to the 2023 NSIBTS Q1 program and 586 were conducted, i.e. 82% of the planned MIK-stations were sampled in 2023. For the 2023 MIK 0-ringer index (corresponding to the 2022 year-class), all hauls north of 51° N were used, in total 569 hauls (for comparison: 2022 = 410 hauls and 2021 = 663 hauls). Thanks to coordination between participants during the survey, almost all ICES squares in the survey area were covered. Furthermore, the main distribution area of the herring larvae in the central and southern North Sea was well covered with at least 3 and mostly 4 MIK hauls per ICES square. Lower coverage with only 1 or 2 hauls per ICES square did mainly occur in the northern part of the survey area, which usually only yields relatively few herring larvae. Overall, the coverage achieved during the 2023 MIK survey was good and can be regarded to provide a representative 0-ringer index.
Number of fish species recorded and notes on any rare species or unusual catches:	Besides the target species herring, larvae and juvenile stages of various other species were caught, including e.g. lemon sole, crystal goby, sandeel, dab, pearlside, pipefish and gobies. As in previous years, catches of sardine larvae were again observed, specifically in the German Bight area and in the Skagerrak.

Stations fished (aims: to complete 716 MIK tows per year)

Country	Gear	Tows planned	Valid	Add.	Inv.	% stations fished	comments
Denmark	MIK	88	90	0	0	102	
France	MIK	108	105	0	0	97	
Germany	MIK	134	80	0	0	60	
Netherlands	MIK	112	112	0	0	100	
Norway	MIK	90	74	0	0	82	
Scotland	MIK	116	78	0	0	67	
Sweden	MIK	68	47	0	0	69	
TOTAL	MIK	716	586	0	0	82	

NOTE: The 2023 WGSINS report presents survey summaries from the 2022 and 2023 NINEL survey. In preceding WGSINS reports the NINEL survey summaries covered the previous year. With the timing of the survey in relation to the working group it is from now on possible to report on in year results.

Northern Irish Northeastern Larvae Survey (NINEL)

Nation:	UK(NI)	Vessel:	RV Corystes
Survey:	NINEL	Dates:	8- 13th November 2022

Cruise	Herring larvae surveys of the northern Irish Sea (ICES area 7aN) have been carried out by the Agri-Food and Biosciences Institute (AFBI), formerly the Department of Agriculture and Rural Development for Northern Ireland (DARD), in November each year since 1993. The surveys have been carried out onboard the RV "Corystes" since 2005, and prior to that on the smaller RV "Lough Foyle". Sampling is carried out on a systematic grid of stations covering the spawning grounds and surrounding regions in the NE and NW Irish Sea. Mean catch-rates (nos.m-2) are calculated over stations to give separate indices of abundance for the NE and NW Irish Sea. Larval production rates (standardized to a larva of 6 mm), and birth-date distributions, are computed based on the mean density of larvae by length class. A growth rate of 0.35 mm day-1 and instantaneous mortality of 0.14 day-1 are assumed based on estimates made in 1993–1997.
Gear details:	Sampling is conducted using a Gulf7 high-speed plankton sampler fitted with 280µm mesh net. A Valeport MIDAS+CTD system is fitted providing flow rates of internal and external Valeport model 002 current meters with 50mm diameter impellers, depth, temperature and salinity profiles. A Seabird SBE19plus CTD is also carried recording depth, temperature, salinity and fluorescence.
Notes from survey (e.g. problems, additional work etc.):	The survey in 2022 was hampered by poor weather condtions with a total of 50 Gulf7 stations sampled out of a planned 62. Depth profiles of salinity and temperature were collected at all stations, and zooplankton samples preserved in 4% formalin.
Number of fish species recorded and notes on any rare species or unusual catches:	1234 herring larvae were measured (TL mm) and preserved in alcohol.

Northern Irish Northeastern Larvae Survey (NINEL)

Nation:	UK(NI)	Vessel:	RV Corystes
Survey:	NINEL	Dates:	6- 10th November 2023

Cruise	Herring larvae surveys of the northern Irish Sea (ICES area 7aN) have been carried out by the Agri-Food and Biosciences Institute (AFBI), formerly the Department of Agriculture and Rural Development for Northern Ireland (DARD), in November each year since 1993. The surveys have been carried out onboard the RV "Corystes" since 2005, and prior to that on the smaller RV "Lough Foyle". Sampling is carried out on a systematic grid of stations covering the spawning grounds and surrounding regions in the NE and NW Irish Sea. Mean catch-rates (nos.m-2) are calculated over stations to give separate indices of abundance for the NE and NW Irish Sea. Larval production rates (standardized to a larva of 6 mm), and birth-date distributions, are computed based on the mean density of larvae by length class. A growth rate of 0.35 mm day-1 and instantaneous mortality of 0.14 day-1 are assumed based on estimates made in 1993–1997.
Gear details:	Sampling is conducted using a Gulf7 high-speed plankton sampler fitted with 280µm mesh net. A Valeport MIDAS+CTD system is fitted providing flow rates of internal and external Valeport model 002 current meters with 50mm diameter impellers, depth, temperature and salinity profiles. A Seabird SBE19plus CTD is also carried recording depth, temperature, salinity and fluorescence.
Notes from survey (e.g. problems, additional work etc.):	The survey in 2023 was completed successfully with a total of 62 Gulf7 stations sampled. Depth profiles of salinity and temperature were collected at all stations, and zooplankton samples preserved in 4% formalin.
Number of fish species recorded and notes on any rare species or unusual catches:	5660 herring larvae were counted in samples, with a sub sampled measured (TL mm).

Northern Ireland MIK Survey (NI-MIK)

Nation:	UK(NI)	Vessel:	RV Corystes
Survey:	NI-MIK	Dates:	25th May – 9thrd June 2023

Cruise	MIK net surveys of the Irish Sea (ICES area 7aN) have been carried out by the Agri-Food and Biosciences Institute (AFBI), formerly the Department of Agriculture and Rural Development for Northern Ireland (DARD), in the spring/early summer each year since 1993. The surveys have been carried out onboard the RV "Corystes" since 2005, and prior to that on the smaller RV "Lough Foyle". Sampling is carried out on a systematic grid of stations covering the main nursery ground of juvenile gadoids (cod (*Gadus morhua)*, whiting (*Merlangius merlangus*) and haddock (*Melanogrammus aeglefinus*) in the western Irish Sea. From 2006 additional sampling in the eastern Irish Sea has also taken place. While the MIK net is deployed during the hours of darkness (30±mins) a GULFVII high speed plankton sampler is deployed during the day to sample zooplankton and ichthyoplankton. Catches of cod, haddock and whiting from the MIK net survey are reported to WGCSE. Since 2018 Neuston sampling for marine litter (micro/macro) have been included in the survey.
Gear details:	GulfVII high-speed plankton sampler fitted with 280µm/425µm mesh net dependent on clogging. A Valeport MIDAS+CTD system is fitted providing flow rates of internal and external Valeport model 002 current meters with 50mm diameter impellers, depth, temperature and salinity profiles. A Seabird SBE19plus CTD is also carried recording depth, temperature, salinity and fluorescence. Between 1993-2018 a 5m^2 modified Isaacs Kidd trawl was deployed. In 2019 a 2 metre diameter midwater ring net replaced this gear. Scanmar sensors are fitted to the MIK frame to provide depth and monitor deployment. A General Oceanics mechanical standard flowmeter records internal flow rates. From 2018 a WP2 net with side floats for neuston sampling fitted with 333µm mesh and internal flowmeter (General Oceanics mechanical standard) has been deployed at GULFVII stations.
Notes from survey (e.g. problems, additional work etc.):	A total of 111 Gulf7, 80 MRN2, 79 WP2 and 3 BGN deployments were made.
Number of fish species recorded and notes on any rare species or unusual catches:	Of the target species 99 whiting, 27 haddock were recorded in the MRN2 catches. Larval fish catches in the Gulf7 were dominated by dragonets (*Callionymidae*) 1004, dab (*Limanda limanda*) 536, clupeiformes (predominantly *Sprattus sprattus*) 426 and 106. In addition, various species of gelatinous zooplankton and crustacea were recorded. 2 *Zeugopterus regius* larvae were identified for the first time in the survey.

Rügen herring larvae survey (RHLS)

Nation:	Germany	Vessel:	CLUPEA
Survey:	363	Dates:	28.02.-14.06.2022

Cruise	Target herring population is the Western Baltic spring-spawning herring. The main aim is to monitor the spawning activity and larval production in a major spawning area, the Greifswald Bay as an indicator of reproductive success in the coastal Baltic Sea. Target data are a high-resolution spatial and temporal records of the larval abundance (35 stations/week) during the entire spawning period as well as hydrographic data (temperature, salinity and oxygen). Weekly mean abundance of larva is summarized in an annual index value (N20) expressing the sum of larvae reaching a critical length of 20 mm by the end of the reproduction season. The collected data are stored nationally and in the ICES Fish Eggs and Larvae dataset.
Gear details:	Bongo net (0.6m diameter) of 335 µm mesh, HYDROBIOS-electronic flow-meters
Notes from survey (e.g. problems, additional work etc.):	The Rügen Herring Larvae Survey (RHLS) in the western Baltic (ICES area IIId/SD24) took place during 16 weeks from Feb (28nd)-June (14th) on FRV "Clupea". In total all 560 stations could be achieved during 51 days at sea. Due to early spawning activity (January) the regular survey was started earlier as in former years, leading to an extended sampling period. During this period, the core program could be fully achieved. However, one week (week 13) had to be cancelled due to vessel problems. One additional survey week was conducted during November 2022 to control for autumn spawner larvae abundance. On each station a vertical CTD-profile was taken (T, Sal, DO2, turbidity, Chl a-fluorescence). Vertical Zooplankton samples (55µm, 200µm) were taken weekly on a grid of 5 stations throughout the Bay.
Number of fish species recorded and notes on any rare species or unusual catches:	Samples are processed for herring larvae exclusively. Remaining samples are stored for potential future processing of other species. Zooplankton samples (55 µm, 200 µm mesh) are taken on 5 stations/week.

Table 4.1.2.3.1. Stations fished

ICES Divisions	Strat.	Gear	Towsplanned	Valid	Add.	Inv.	% stations fished	comments
24	N/A	Bongo	595	560			94 %	

Strat: strata; Add: Additional tows; inv: Invalid

Baltic Ichthyoplankton Surveys (BIS)

Nation:	Denmark, Poland, Germany	Vessel:	DANA, BALTICA, ALKOR & others
Survey:	BIS-Baltic Ichthyoplankton Surveys	Dates:	Monthly from March-September & November, 2023

Cruise	The Baltic Ichthyoplankton Surveys (BIS) are an annual series of individual surveys conducted by several participating institutes from Denmark, Poland and Germany. The surveys aim to cover the main spawning area of the target species, Eastern Baltic cod (EBC), throughout its spawning season, i.e. individual surveys cover a standard grid of 45 Bongo net stations and are usually conducted in March, April, May, June, July, August and November, in some years also in September. The surveys provide a stock biomass estimate for EBC based on egg abundances and a recruitment index based on larval abundances. In addition, the surveys provide information on eggs and larvae of several other species, including sprat, herring and flounder. On some cruises, Bongo net hauls are also conducted on additional stations to supplement the standard grid, and sometimes also vertically resolved Multinet sampling is conducted. Besides, most surveys are multidisciplinary and also include sampling of adult fish (e.g. for fecundity estimates needed for egg production methods) and zooplankton (e.g. as prey for larvae) as well as hydrographic measurements. The collected data are stored in national databases, and the time series of egg based stock biomass estimates and recruitment indices for EBC are updated every year and provided to WGBFAS for use in the stock assessment of EBC.
Gear details:	Bongo net (0.6 m diameter) of 335 and 500 µm mesh, flowmeters + on some cruises additional other gears, e.g. different types of fishing trawls, Baby-Bongo net (0.2 m diameter) of 150 µm mesh, WP-2 net (100 µm mesh), Multinet (335 µm mesh)
Notes from survey (e.g. problems, additional work etc.):	In 2023, a total of 8 individual BIS surveys were conducted in March, April, May, June, July, August, September and November. On most cruises, the entire 45 station standard grid was sampled. On the cruises in March & November, 1 and 2 standard stations could not be sampled, respectively. On the cruise in August, only 27 of the 45 stations could be sampled due to rough weather. In total, 339 of the planned 360 standard stations were sampled in 2023, corresponding to 94%.
Number of fish species recorded and notes on any rare species or unusual catches:	In addition to cod as the target species, eggs and larvae of several other species are caught. Depending on the sampling month, abundant species include sprat, herring, flounder, plaice, sandeel and gobies. Additional species occur at relatively low abundances, including e.g. rockling, sea snail, turbot and sculpin. In addition, various species of gelatinous plankton are recorded. The last survey in November yielded record high abundances of the invasive American comb jelly *Mnemiopsis leidyi* (approx. 10 times higher than the long-term average in November recorded since 2008)

Stations fished

ICES Divisions	Strat.	Gear	Tows planned	Valid	Add.	Inv.	% stations fished	comments
25	N/A	Bongo	360	339	Several	0	94 %	