ALKOR-Berichte

# *Biological oceanography and fishery science practical at Sea in the framework of the SeaRanger educational programme*

Cruise No. AL607

February 10$^{th}$ – February 16$^{th}$ 2024
Kiel (Germany) – Kiel (Germany)
SeaRanger

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2024

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# 1 Cruise Summary

## 1.1 Summary in English

This cruise was conducted as part of the educational training of fishers in the framework of the transdisciplinary SeaRanger program which is scientifically accompanied by the Institute of marine ecosystem and fisheries Science (IMF) at the University of Hamburg (UHAM), the Christian-Albrechts University Kiel, Centre for Ocean and Society (CeOS), the Thuenen-Institute for Baltic Sea fisheries (TI-OF), and the German Centre for Integrative Biodiversity Research (iDiv) in the framework of the joint project SpaCeParti (Coastal Fishery, Biodiversity, Spatial Use and Climate Change: A Participative Approach to navigate the Western Baltic Sea into a Sustainable Future; Grant no. 03F0914) funded by the BMBF. In order to give the fishermen as realistic an application of the standard monitoring techniques as possible, the trip was planned in such a way that the training part was integrated into a scientific monitoring programme focussing on the spawning activity of fish in the Belt Sea. By sampling a standardised station grid contributing to the joint long-term sampling efforts in the Western Baltic Sea which are internationally coordinated by the WBCF (Western Baltic cod Forum), the fishers learned how plankton, fish and water samples are taken, preserved, and analysed and gained a comprehensive insight into the hydrography and fauna of the western Baltic.

Similar to the previous cruise AL606 in January 2024 conducted by the IMF no cod larvae and generally less larvae compared to previous years were observed in the Bongo 500 µm net samples from the Plankton grid stations, potentially indicating a delayed spawning activity of fish in the Belt Sea potentially related to the comparably low water temperatures in winter 2023/24.

## 1.2 Zusammenfassung

Diese Fahrt wurde als Teil der Ausbildung von Fischern im Rahmen des transdisziplinären SeaRanger-Programms (d.h. im Ausbildungsgang Fachwirt für Fischerei und Meeresumlwet) durchgeführt, das vom Institut für Marine Ökosystem- und Fischereiwissenschaften (IMF) der Universität Hamburg (UHAM), der Christian-Albrechts-Universität zu Kiel, Centre for Ocean and Society (CeOS), dem Thünen-Institut für Ostseefischerei (TI-OF) und dem Deutschen Zentrum für integrative Biodiversitätsforschung (iDiv) im Rahmen des Verbundprojektes SpaCeParti (Coastal Fishery, Biodiversity, Spatial Use and Climate Change: Ein partizipativer Ansatz, um die westliche Ostsee in eine nachhaltige Zukunft zu navigieren; Förderkennzeichen 03F0914) vom BMBF gefördert. Um den Fischern eine möglichst realistische Anwendung der Standardüberwachungsmethoden zu vermitteln, wurde die Reise so geplant, dass der Schulungsteil in ein wissenschaftliches Überwachungsprogramm mit Schwerpunkt auf der Laichaktivität der Fische in der Beltsee integriert wurde. Durch die Beprobung eines standardisierten Stationsrasters, das zu den gemeinsamen langfristigen Beprobungsmaßnahmen in der westlichen Ostsee beiträgt, die vom WBCF (Western Baltic cod Forum), international koordiniert werden, lernten die Fischer, wie Plankton-, Fisch- und Wasserproben genommen, aufbewahrt und analysiert werden, und erhielten einen umfassenden Einblick in die Hydrographie und Fauna der westlichen Ostsee.

Ähnlich wie bei der vorangegangenen Fahrt AL606 im Januar 2024, die von der UHAM durchgeführt wurde, wurden in den Bongo 500 µm-Netzproben der Plankton-Rasterstationen keine Dorschlarven und weniger Larven als in den Vorjahren beobachtet, was möglicherweise auf eine verzögerte Laichaktivität der Fische in der Beltsee hinweist, die möglicherweise mit den vergleichsweise niedrigen Wassertemperaturen im Winter 2023/24 zusammenhängt.

# 2 Participants

## 2.1 Principal Investigators

**Table 2.1.1** List of Principal Investigators of the SeaRanger cruise.

| Name | Academic title | Institution |
|---|---|---|
| Funk. Steffen | Dr. rer. nat. | IMF |
| Mittermayer, Felix | Dr. rer. nat. | GEOMAR |

## 2.1 Scientific Party

**Table 2.1.1.** List of scientific party of cruise AL607 – Part A.

| Name | Discipline | Institution |
|---|---|---|
| Funk, Steffen, Dr. rer. nat. | Chief scientist; PostDoc | IMF |
| Mittermayer, Felix, Dr. rer. nat. | Deputy chief scientist, PostDoc | GEOMAR |
| Klein, Amalia | Student | IMF |
| Ressing,Tobias | PhD student | IMF |
| Willim, Jana | PhD student | GEOMAR |
| Karnatz, Josefine | PhD student | GEOMAR |
| Degraaf, Kai | Scientific employee | CeOS |
| Handke, Kai | Trainee, fisher | BilSE |
| Höpfner, Karsten | Trainee, fisher | BilSE |
| Labahn, Mathias | Trainee, fisher | BilSE |
| Michalak, Björn | Trainee, fisher | BilSE |
| Ottenstein, Birger | Trainee, fisher | BilSE |

**Table 2.1.2.** List of scientific party of cruise AL607 – Part B.

| Name | Discipline | Institution |
|---|---|---|
| Funk, Steffen, Dr. rer. nat. | Chief scientist; PostDoc | IMF |
| Hauten, Elena | PhD student | IMF |
| Ressing,Tobias | PhD Student | IMF |
| Weidenauer, Leandra | Student | GEOMAR |
| Willim, Jana | PhD student | GEOMAR |
| Thomsen, Ilka | Scientific employee | GEOMAR |
| Degraaf, Kai | Scientific employee | CeOS |
| Diedrick, Henry | Trainee, fisher | BilSE |
| Dunkelmann, Kai | Trainee, fisher | BilSE |
| Martitz, Gustav | Trainee, fisher | BilSE |
| Saager, Martin | Trainee, fisher | BilSE |
| Spreer, Rene | Trainee, fisher | BilSE |

### 2.2 Participating Institutions

| | |
|---|---|
| BilSE | Institut für Bildung und Forschung |
| CeOS | Centre for Ocean and Society, Christian-Albrechts-University of Kiel |
| IMF | Institute of Marine Ecosystem and Fisheries Science, University of Hamburg |
| GEOMAR | GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel |

## 3 Research Program

### 3.1 Description of the Work Area

The working area of AL607 was located in the Kiel Bight, Fehmarn Belt, and Mecklenburg Bight, which are all part of the Belt Sea (ICES subdivision (SD)22). The Belt Sea is a stratified, brackish-water area (common salinity range: 10 to 25 PSU), which together with the Arkona Sea (SD24) and the Sound (SD23) forms the Western Baltic Sea (WBS) (Fig. 3.1.1). The Western Baltic Sea is characterized by several shallow obstacles such as the Darss Sill, limiting inflows of water with high salinities from the Kattegat region to the eastern parts of the Baltic Sea. This limited saltwater inflow in combination with river runoffs results in a constant decrease of salinity from the western to the eastern parts of the Baltic Sea. The Belt Sea is microtidal (tidal range: ~ 10 cm) and characterized by wind-induced fluctuations in hydrographic conditions (Leppäranta and Myrberg, 2000; Snoeijs-Leijonmalm and Andrén, 2017). This is caused by changes in inflow of more saline bottom water from the Kattegat and surface outflow of less saline water from the central and southern Baltic Sea through the Danish Straits and the Darss sill. SD22 and SD23 are known as the distributional core area of the Western Baltic cod (*Gadus morhua*) stock. Here, stock mixing with the more easterly distributed Eastern Baltic cod (*Gadus morhua callarias*) is considered negligible (ICES, 2019).

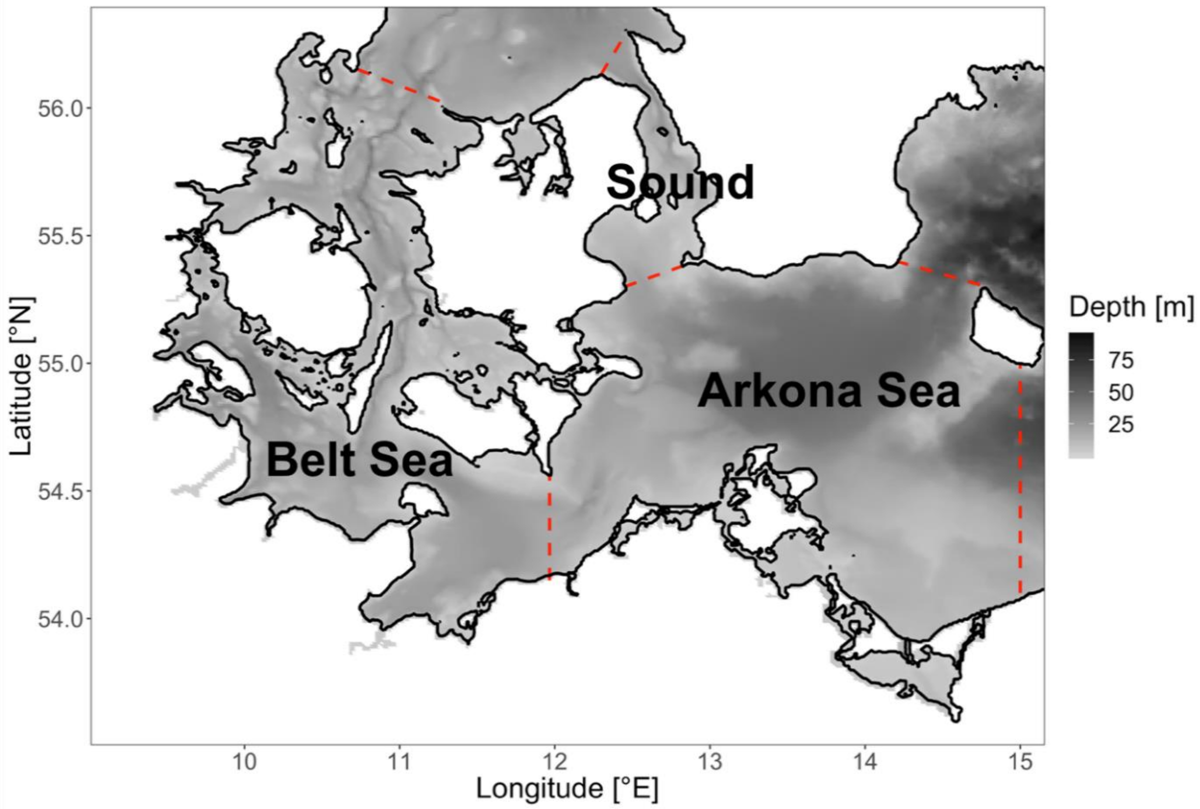


**Figure 3.1.1.** Bathymetry of the Western Baltic Sea. Dashed red lines indicate borders between ICES Subdivisions (SD22 – Belt Sea; SD23 – Sound, and SD24 – Arkona Sea). Figure was taken from Funk, 2020.

## 3.2 Aims of the Cruise

This trip was planned as at-sea practical for the newly established Sea Ranger educational training, which started for the first time in October 2023 and which is scientifically accompanied by the Institute of marine ecosystem and fisheries Science (IMF) at the University of Hamburg (UHAM), the Christian-Albrechts University Kiel, Centre for Ocean and Society (CeOS), the Thuenen-Institute for Baltic Sea fisheries (TI-OF), and the German Centre for Integrative Biodiversity Research (iDiv) in the framework of the joint project SpaCeParti (Coastal Fishery, Biodiversity, Spatial Use and Climate Change: A Participative Approach to navigate the Western Baltic Sea into a Sustainable Future; Grant no. 03F0914) funded by the BMBF.

It was planned to teach the trainees in various sampling techniques in marine oceanography, marine ecology, and fisheries science. During this multi- and transdisciplinary research and teaching cruise we want to convey a number of hard and soft skills to the fishers as well as spark their interest for the Baltic Sea ecosystem in general and for participating in future monitoring programs in their role as Sea Rangers. Participation in the cruise allows the fishers to learn about mechanisms, methods and current topics in, but not limited to biological oceanography, marine ecology, hydrography, fisheries ecology, global change ecology, and invasion ecology. Further several samples taken by the fishers will be analysed directly on board. By training the fishermen in scientific sampling and monitoring programmes for part of their future work as Sea Rangers, the internship at sea will be a key skills module within the overall Sea Ranger training programme.

*Scientific objectives*

The Belt Sea, chosen as our research area demonstrates an ecosystem under high anthropogenic pressure including climate change effects and unsustainable high fishing pressure leading to the collapse of the historically commercially most-important fish species cod and herring. Recent investigations on these fish species on our doorstep revealed severe knowledge gaps concerning their ecology. The collapse of the Western Baltic cod species is mainly attributed to unsustainable fishing pressure and several years of low recruitment (Möllmann et al., 2021). The reasons behind these poor recruitment successes are, however, not understood sufficiently yet. One potential explanation might be a shift in spawning phenology, wherein the increasing frequency of occurrence of mild winters may lead the cod to spawn earlier resulting probably in match-mismatch situations of early spawned eggs and larvae and thus an overall decreased recruitment success (see e.g., Funk and Möllmann, 2021, 2022, 2023). Ichthyoplankton samples taken in the here proposed cruise will complement internationally coordinated sampling efforts by the WBCF and thus will help to better our overall understanding on the western Baltic cod spawning phenology. Integrating the sampling here in the practical of educational SeaRanger programme, will sensitize the fishers on the use and importance of scientific monitoring program, by learning the soft skills and the theoretical background of its usage on a species-example where most of them are extremely familiar with, since it represents one of the historically most important commercially used species. By giving the theoretical background on current challenges in fisheries science and the knowledge-gaps exist, our approach will also help to build trust between fishers and fisheries scientists, which will be a prerequisite for future engagement of the SeaRangers in scientific monitoring.

Planned scientific work on western Baltic cod spawning ecology include:

1. Ichthyoplankton sampling of cod eggs and larvae and zooplankton sampling at a predefined station grid (35 stations)
2. single fish analysis of adult cod at selected trawl stations (i.e., knowns spawning sites of cod) including later aging of cod otoliths and staging of cod gonads
3. taking of cod stomach samples to complement the cod stomach long-time data series of the University of Hamburg
4. General monitoring of the fish fauna at selected trawl stations

*Teaching objectives*

By following the scientific objectives above, the fishers will familiarize themselves with the theoretical and practical applications of equipment used in modern physical oceanography and hydrography. After an initial training phase, the fishers will have consolidated their skills in using the most common devices, such as CTD, plankton nets (e.g., Bongo, WP2, Apstein) and water samplers. In addition, they will perform a number of chemical analyses of water parameters on board, such as oxygen and chlorophyll A to verify the sensor measurements. The use of diverse plankton nets for various applications will be taught to the fishers during the initial phase of the cruise and it is expected that the students can deploy simpler gear (CTD, Bongo, WP2) and handle the samples and their analysis with only minimal supervision during later phase of the cruise. Preliminary analyses such as species identification and abundance estimations of key plankton species and of caught fish species from the trawl samplings will be conducted continuously during the cruise.

The detailed teaching objectives can be separated into the following main categories:

1. General work on board a research vessel
   - Personal safety during work on deck and in the laboratories
   - Data curation for data depositories (Meta data access, Stations lists, data deposition)

2. Methods for the monitoring of environmental parameters
   - CTD
   - Water sampler (including preservation of (e.g. salinometry) samples for later analysis ashore)

3. Methods in Zoo- and ichthyoplankton monitoring
   - Bongo nets, Apstein, WP2, Multinet midi (including preservation and preliminary analysis (e.g. sorting out of cod larvae)

4. Methods in fish monitoring
   - Scientific evaluation of a trawl catches (including taking of scientific correct subsamples, single fish measurements, taking of stomach & otolith samples, gonadal ripening and recording length-frequencies)

Practical work on board and in the laboratories will be intermixed with short lectures (~30 min) and workshops by the onboard supervisors of the GEOMAR and University of Hamburg. The aim of these lectures is to provide parallel in-depth theoretical background to the measurements and work on board.

Realised key-lectures and workshops during the practical cruise:

1. Scientific background of the cruise – challenges in monitoring and recruitment of Western Baltic cod (by S. Funk)
2. Fish maturity stages and identification (by A. Klein/ S. Funk & T. Ressing)
3. Small introduction in Belt Sea Zooplankton (by F. Mittermayer/ J. Willim)
4. Current work of IMF, GEOMAR and WBCF on Western Baltic cod ecology (especially highlighting the collaborative projects with local small scale fisheries) (by S. Funk)
5. Current work on Baltic flounder feeding ecology (by T. Ressing)
6. Workshop – Gear sustainability assessment (by T. Ressing)
7. Workshop – Using FEK (fishers’ ecological knowledge) to identify Belt Sea cod spawning habitats (by S. Funk)
8. Workshop – Feedback (K. Degraaf)

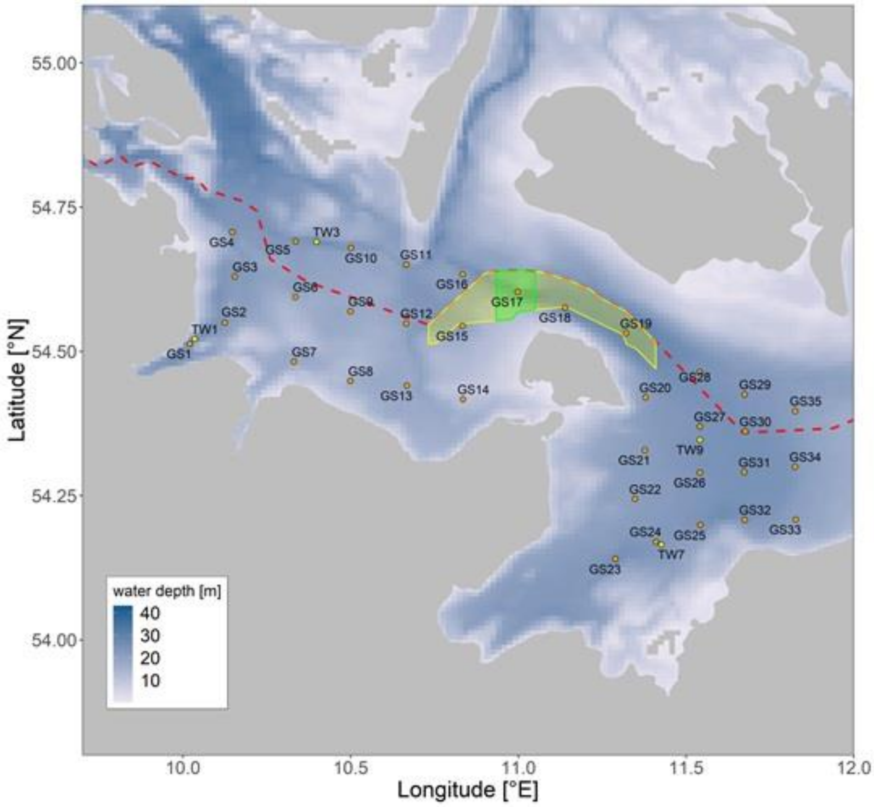


**Figure 3.2.1**. Bathymetric map of the study area displaying planned zooplankton (GS numbers) and trawl fishery (TW numbers) stations for the educational cruise AL607. Orange dots (GS stations) indicate CTD and BONGO net stations. Red dashed line depicts EEZ borders. Yellow polygon displays the nature conservation area Fehmarn Belt. Green polygon indicates an area in the Fehmarn Belt where recreational fishing is prohibited.

## 3.3 Agenda of the Cruise

It was planned to realize a plankton grid sampling consisting of 35 BONGO net and CTD stations complemented by 4 trawl hauls.

Hydrographic data

Detailed collection of the hydrographic conditions at the working area including fluorescence, oxygen, salinity, pH and temperature.

Water samples for salinometry taken with Niskin bottles should be preserved for subsequent measurements ashore.

Zoo- and ichthyoplankton data

Cod larvae of Bongo net 500 µm should be collected directly out of the samples, and deep frozen at -80°C for subsequent condition analyses in the laboratory. Bongo-, WP2, Apstein and Multinet-samples should be preserved in formalin for later detailed zoo- and ichthyoplankton community and size composition analysed coordinated by the WBCF.

Fishery data

Sampling of the occurring fish fauna at for-defined sampling stations at traditional cod spawning grounds including the collection of individual fish data of cod. In detail it was planned to record full weight, gutted weight, liver weight, sex, maturity stage, gonad weight, stomach fullness, and to take otolith, stomach, fin clip and muscle tissue samples. From female cod in maturity stage four gonad samples for later fecundity analysis should be taken.

Additionally, size distribution and total catch weight should be recorded for all other fish species caught.

- Cod stomach samples were taken to supplement the Western Baltic cod stomach data base of the University of Hamburg dating back to 2016 (see Funk et al., 2021).
- Cod fin clips were taken for potential cod stock discrimination analyses using genetics.
- Cod muscle tissue samples were taken for stable isotope analysis.
- Cod samples were taken for subsequent aging.
- Cod gonad samples were taken for fecundity analysis.

Responsible marine research and mitigation measures

Measures will be taken according to the "Declaration of responsible research" and the "Code of Conduct for Responsible Marine Research in the Deep and High Seas of the OSPAR Maritime Area".

*Cod catches – "As small as possible, as large as necessary"*

Although not listed as endangered species by HELCOM the cod stock in the Western Baltic Sea is currently in a critical state. Fishing pressure should thus be reduced to a necessary minimum. Given the high relevance of the winter cod cruises for gaining important knowledge about spawning behaviour in January of Western Baltic cod, the planned fishery is thus guided by the maxim: keep the cod catches "as small as possible and as large as necessary". Compared to commercial trawlers, our fishing effort is considered very low. This was also clearly illustrated by the January 2021 cruise where we trawled for a total of 8.5 hours, which was less than the trawl time of a single average trawler in one day (pers. comm. with local trawl captains by S. Funk). Furthermore, the young fish trawl net we use is smaller than most commercial bottom trawl nets, so the total swept area is much less.

We aim for a total of about 20 cod per 10cm length class per haul in order to enabling statistically valid statements about condition, maturity distribution, sex ratios or nutrition. With an average of 3 length classes that can be expected, considering the current age structure of the stock, this results in a target number of about 60 cod per haul. This would mean a target catch of 780 cod for the whole cruise (when bottom trawling at 13 stations) which highlights that the overall impact can be considered rather negligible. Since trawling efforts of the last years cruises however, yielded only in minor cod catches our fishing impact can be considered even less than in maximum assumed. It can be assumed that only at very few stations this target number of 60 cod will be actually reached. Furthermore, the use of an acoustic net sounder helps to estimate the expected number of fish in the catch during the haul, so that haul times can be shortened in the case of unexpected high number of fish echoes in order to avoid unnecessarily large catches of cod. On the winter cod cruise 2021 we caught a total of 35 cod (which corresponds to the total allowed daily catch of 5 anglers in the Belt Sea). Even those small numbers of individuals already provide valuable and important insights on the early winter spawning activity of cod in the Western Baltic Sea. Moreover, the gained knowledge may result in management adaptations (i.e., time closures of spawning sites for commercial fisheries, or the extension of the closed season to January) which could promote a more sustainable use of the Western Baltic cod stock.

We also used the maxim of keeping our fishing impact low when planning and conducting rod and reel fishery. Here, the haul can be stopped if the target size of 10 animals for a length class is exceeded. The increased focus in recent years away from trawl hauls towards more angling hauls also makes it possible to minimise the bycatch of other non-target species considerably.

## 4 Narrative of the Cruise

RV ALKOR departed from GEOMAR pier in Kiel on March 1$^{st}$ at 08:00am heading to the first plankton grid station in the Kiel Bight (GS 1, Fig. 3.2), where the station work started. At this first stations the trainees have been introduced into different zooplankton sampling methods including Bongo net, Apstein, WP2 and Niskin-Bottle. Furthermore, the CTD profile taken at the stations were explained to the trainees. After this first comprehensive introductory station Plankton station work was continued while. Due to the weather forecast predicting strong winds with gusts > 8 Bft on Saturday, it was decided to sample all stations in the southern Kiel Bight, and to start with trawl fishery on Saturday morning in the Bight of Eckernförde instead of heading further east towards the Mecklenburg Bight. On Saturday two trawl stations were conducted in the Bight of Eckernförde at TW1. Here the fishers were trained in how to take scientifically correct subsamples, how to obtain length-frequencies and how to conduct single fish analyses including determination of maturity stages and taking of Otoliths on the example of caught juvenile cod and juvenile and adult flatfishes. After the wind calming down at Saturday afternoon, RV ALKOR headed towards the Mecklenburg Bight. On the way the three GS Stations GS17, GS18 and GS19 in the Fehmarn Belt were sampled. At Monday morning at 08:00am the station work was continued at trawl station TW9 which included a trawl haul, a CTD cast with water sampler and a multinet haul. At 01:00pm RV ALKOR headed towards the port of Rostock Marienehe where the change of participants took place.

On Tuesday at 08:00am RV ALKOR departed from the Pier at Rostock Marienehe and headed towards GS 33, where the station work was continued. At this first stations the trainees have been introduced into the basics of zooplankton sampling methods on the example of a Bongo net haul. Furthermore, the CTD profile taken at the stations were explained to the trainees. In the course of the Tuesday all planned GS stations in the Mecklenburg Bight (i.e., GS20 to GS35) have been completed and it was decided to head again to the Kiel Bight where Plankton station was continued. In the early Wednesday afternoon all GS stations had been successfully sampled followed by a trawl haul at TW3. Here the fishers were trained in how to take scientifically correct subsamples, how to obtain length-frequencies and how to conduct single fish analyses including determination of maturity stages and taking of Otoliths on the example of caught juvenile and adult cod and flatfishes. For Tuesday morning it was decided to conduct another trawl haul in the west of the Kiel Bight, north of the Bight of Eckernförde, where the trainees were furthermore introduced into different kinds of plankton sampling including WP2, Apstein, Niskin bottles and multinet. After processing of the catches, RV ALKOR headed back to its homeport Kiel, where the cruise ended at 03:12pm.

# 5 Preliminary Results

## 5.1 Hydrography

CTD profiles (i.e., CTD casts with probe without water sampler) were obtained from a total of 38 sampling stations during AL606. Highest bottom salinities with > 21 PSU were observed in the northern and central Kiel Bight (i.e., northern Bight of Hohwacht).

Surface salinities ranged between 9.5 PSU and 18.5 PSU with a decreasing spatial pattern from western to eastern parts of the sampling area. Interestingly, even in the Fehmarn Belt considerably low surface salinities < 14 PSU were observed indicating freshwater surface outflows from the eastern parts of the Baltic, resulting from strong easterly winds prior to and during the first days of the cruise.

In the literature, salinities between 18 to 33 PSU are given as range for neutral egg buoyancy of Western Baltic cod with an optimum of 20-22 PSU (von Westernhagen, 1970; Westerberg, 1994; Nissling and Westin, 1997). Based on this salinity range conditions for cod egg buoyancy and thus conditions for a successful spawning could be found in Kiel. Thus, as already mentioned in the last years' cruise reports (see Funk and Möllmann, 2021, 2022, 2023) the question can be raised, if any spawning activity in the central and eastern Mecklenburg Bight (see Figure 5.1.1D) during the survey period would have resulted in successful reproduction.

However, as also already mentioned in the last years' winter cod cruise report (see Funk and Möllmann, 2021, 2022, 2023) most of the cod egg buoyancy experiments were conducted with cod samples originating from the north-western Belt Sea and information from the Mecklenburg Bight are extremely limited. Since, in the Arkona Basin neutral cod egg buoyancy was already observed at a salinity of 13.7 PSU ± 1.3 PSU (Nissling and Westin, 1997), at least a potential for a lower salinity threshold for neutral egg buoyancy in Western Baltic cod might be considered. Further egg buoyancy experiments (for example in the framework of future winter cod cruises) may shed light on small scale difference in cod egg buoyancy requirements within the Belt Sea, and thus may provide valuable information on how successful observed spawning activities potentially are.

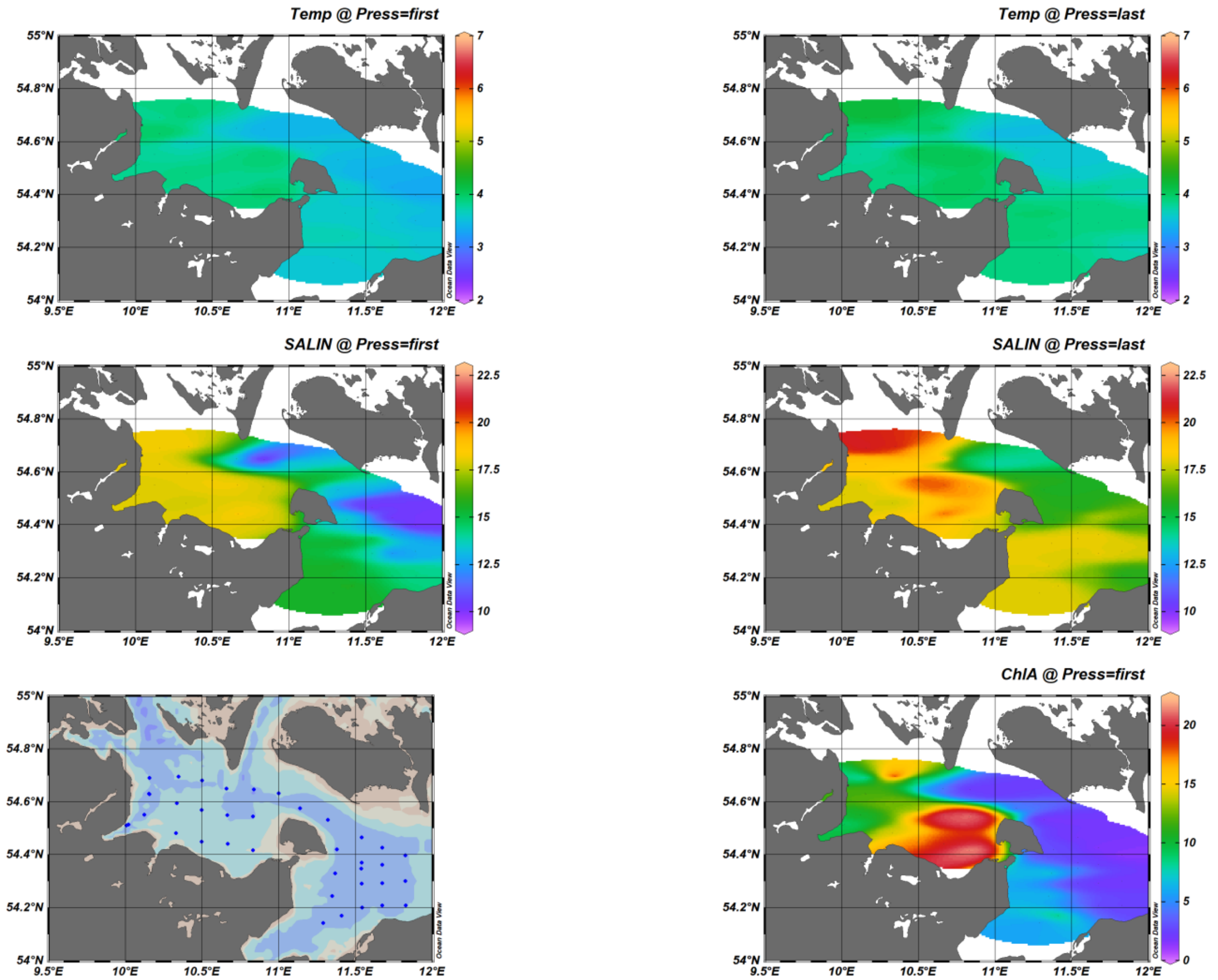


**Figure 5.1.1.** Interpolated hydrographic conditions in the Belt Sea in January 2024 obtained from CTD casts (Left top panel: Temperature [°C] at surface layer; left mid panel: Salinity [PSU] at surface layer; left bottom panel: bathymetric map of the study area displaying CTD sampling stations; right top panel: Temperature [°C]; right mid panel: Salinity [PSU] at bottom layer; right bottom panel: Chlorophyll-a [µg/L] at surface layer. Graphical visualization was made using the software tool Ocean Data View (Schlitzer, 2018).

## 5.2 Fishery

Trawling

During AL607, a total of five trawl hauls were conducted in Kiel Bight (n = 4) and in Mecklenburg Bight (n = 1). Due to malfunction during the fifth haul, the total catches of these haul cannot be considered representative.

A total of 26 different fish species were recorded in the trawl catches. In total 1708.348 kg of fish had been caught with plaice clearly dominating the catch compositions of all four trawl hauls (Tab. 5.2.2). Cod contributed only to minor fractions of the trawl catches. In total 45 cod individuals with a total weight of 8.367 kg were caught during trawling, with small cod < 30 cm clearly dominating the catches (Tab. 5.2.1; Fig. 5.2.2).

**Table 5.2.1.** Total catch obtained from trawl fishing during AL607.

| Cruise | Year | Month | Day | Gear | Station | Haul | Species | Weight | Numbers |
|---|---|---|---|---|---|---|---|---|---|
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Clupea harengus* | 3.173 | 358 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Sprattus sprattus* | 2.894 | 319 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Gadus morhua* | 0.179 | 10 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Merlangius merlangus* | 0.334 | 16 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Enchelyopus cimbrius* | 0.023 | 2 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Platichthys flesus* | 3.97 | 16 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Limanda limanda* | 110.89 | 2663 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Pleuronectes platessa* | 210.86 | 3504 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Microstomus kitt* | 0.175 | 1 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Myoxocephalus scorpius* | 0.653 | 9 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Pomatoschistus sp.* | 0.03 | 36 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Gobius niger* | 0.076 | 10 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 11-2 | 1 | *Eutrigla gurnardus* | 0.047 | 3 |
| | | | | | | | | | |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Clupea harengus* | 3.378 | 199 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Sprattus sprattus* | 3.166 | 249 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Gadus morhua* | 0.054 | 2 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Merlangius merlangus* | 0.063 | 5 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Platichthys flesus* | 1.681 | 8 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Limanda limanda* | 44.68 | 1020 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Pleuronectes platessa* | 108.23 | 2233 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Myoxocephalus scorpius* | 0.883 | 14 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Gobius niger* | 0.018 | 2 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Agonus cataphractus* | 0.054 | 2 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Zoarces viviparus* | 0.006 | 1 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Eutrigla gurnardus* | 0.068 | 2 |
| AL607 | 2024 | 2 | 11 | TV3_520 | 12-1 | 2 | *Pomatoschistus sp.* | 0.012 | 15 |
| | | | | | | | | | |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Clupea harengus* | 5.93 | 211 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Sprattus sprattus* | 54.16 | 5743 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Gasterosteus aculeatus* | 5.507 | 488 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Gadus morhua* | 1.583 | 12 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Merlangius merlangus* | 0.552 | 8 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Enchelyopus cimbrius* | 0.119 | 2 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Platichthys flesus* | 15.06 | 65 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Limanda limanda* | 50.22 | 687 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Pleuronectes platessa* | 196.97 | 3528 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Hippoglossoides platessoides* | 0.197 | 1 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Myoxocephalus scorpius* | 2.115 | 32 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Lumpenus lampaetraformis* | 0.692 | 89 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Neogobius melanostomus* | 0.022 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Cyclopterus lumpus* | 0.04 | 1 |
| AL607 | 2024 | 2 | 12 | TV3_520 | 16-2 | 3 | *Eutrigla gurnardus* | 0.043 | 1 |
| | | | | | | | | | |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Clupea harengus* | 9.75 | 781 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Sprattus sprattus* | 11.07 | 1210 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Gadus morhua* | 15.946 | 16 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Merlangius merlangus* | 4.68 | 120 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Melannogrammus aeglefinus* | 0.791 | 5 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Enchelyopus cimbrius* | 0.325 | 11 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Microstomus kitt* | 0.725 | 3 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Platichthys flesus* | 143.28 | 675 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Limanda limanda* | 82.55 | 842 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Pleuronectes platessa* | 478.76 | 7469 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Arnoglossus laterna* | 0.263 | 18 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Solea solea* | 1.279 | 12 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Hippoglossoides platessoides* | 4.74 | 82 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Lumpenus lampaetraformis* | 0.187 | 18 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Myoxocephalus scorpius* | 0.339 | 5 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Callionymus lyra* | 0.126 | 3 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Agonus cataphractus* | 0.051 | 2 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Eutrigla gurnardus* | 1.295 | 13 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Zoarces viviparus* | 0.167 | 5 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 39-1 | 4 | *Syngnathus sp.* | 0.001 | 3 |
| | | | | | | | | | |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Clupea harengus* | 0.757 | 51 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Sprattus sprattus* | 0.548 | 69 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Gadus morhua* | 0.053 | 5 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Merlangius merlangus* | 0.6 | 10 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Platichthys flesus* | 0.3 | 2 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Limanda limanda* | 6.72 | 120 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Pleuronectes platessa* | 114.01 | 1812 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Scophthalmus rhombus* | 0.06 | 1 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Neogobius melanostomus* | 0.017 | 2 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Eutrigla gurnardus* | 0.135 | 1 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Lumpenus lampaetraformis* | 0.011 | 1 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Pomatoschistus sp.* | 0.004 | 2 |
| AL607 | 2024 | 2 | 14 | TV3_520 | 41-1 | 5 | *Syngnathus sp.* | 0.001 | 1 |

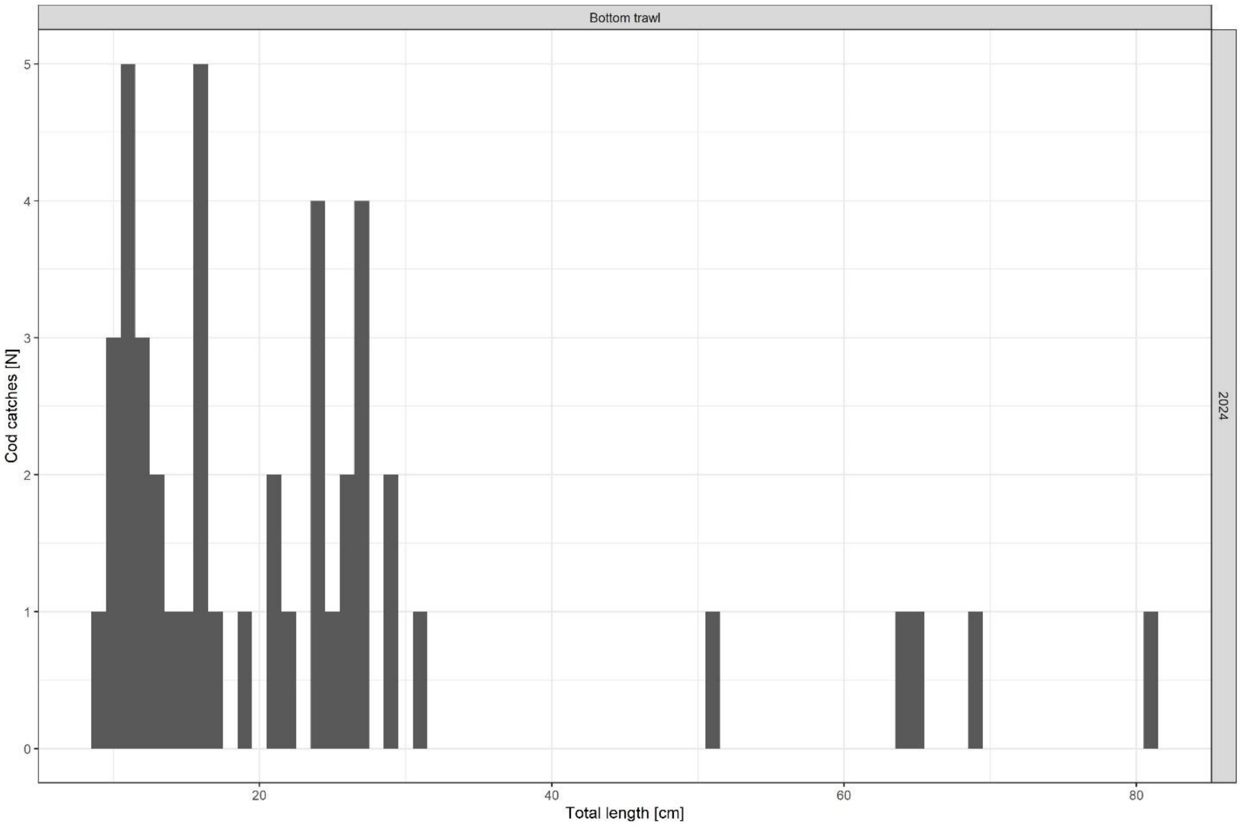


**Figure 5.2.1.** Length distribution of cod catches obtained from bottom trawling during AL607.

Cod maturity stages

We found cod in spawning stages (i.e. stages 5 to 7 [see Tomkiewicz et al., 2002]) in Kiel Bight and Mecklenburg Bight (Fig. 5.2.2). Most of the analysed cod have been male individuals. In contrast to our observation during the January cruise we observed no cod in post-spawning stage (i.e., stages 8). However, the observations are hardly comparable due to the small total number of cod caught and analysed during AL607. For example, in case of female cod, only individuals < 31 cm had been caught during bottom trawling at AL607. In case of male individuals, no cod in length class 41-50 cm could be caught and analysed. With exception of the length class 21-30 cm all analysed cod were found to be in spawning stages (i.e. stage 5 to 7), while we also observed cod in ripening stages for all length classes < 61 cm in January 2024 at AL606. This may indicate that spawning activity was further progressed in February than in January, matching the expectation that a) large cod start earlier to spawn than their smaller conspecifics and b) that February is the main spawning season of Western Baltic cod, while January can be more seen as its starting point. However, as stated above, due to the small number of samples obtained during AL607 all observations should be treated with caution.

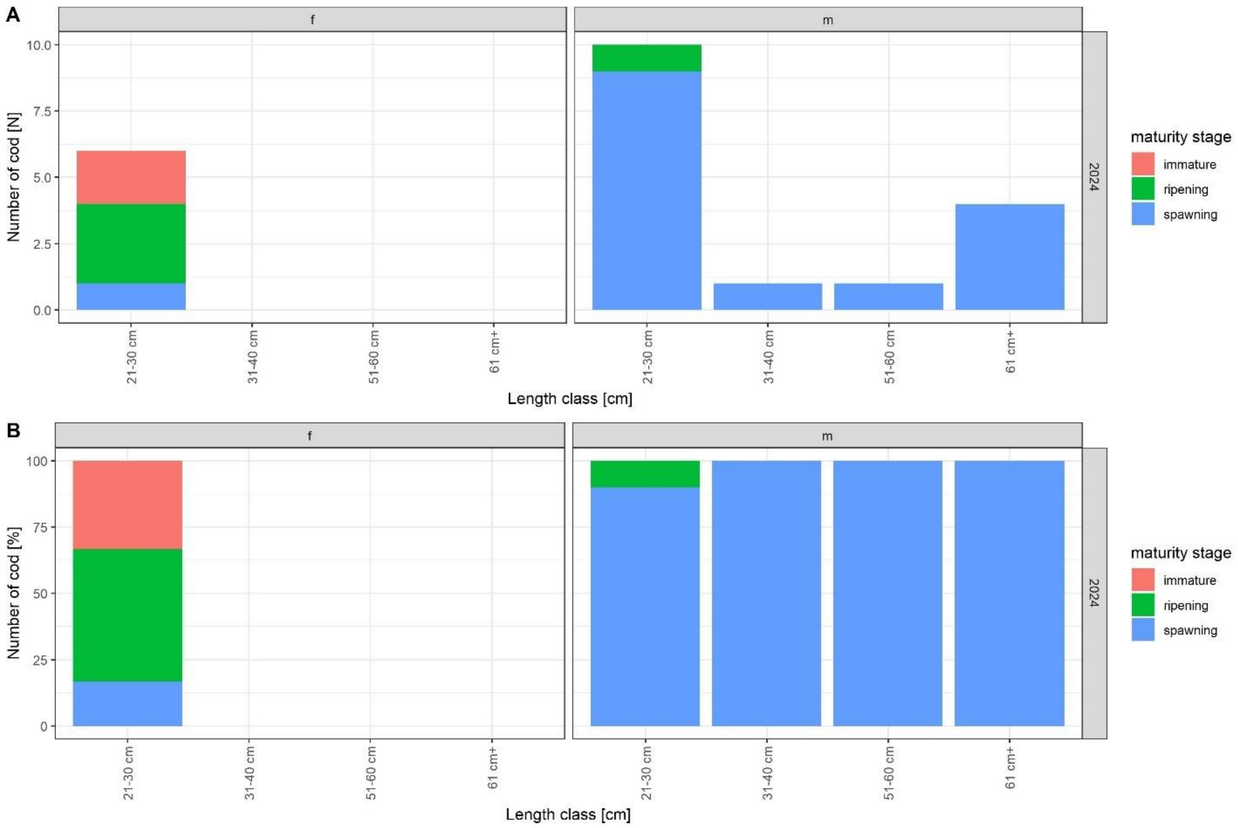


**Figure 5.2.2.** Maturity stage distribution of cod caught during AL607 per sex and 10 cm-length class (f = females, m = males). Note that individuals < 20 cm have been not sexed onboard and are thus not included in the plot.

## 5.3 Ichthyo- and Zooplankton Sampling

Zoo- and ichthyoplankton samples were obtained from a total of 35 BONGO stations. BONGO net 500 µm samples were also checked directly on board for occurrence of cod larvae by trained scientists (F. Mittermayer, J. Willim, and L. Weidenauer). Flatfish larvae were removed from the samples and deep-frozen for later microstructure analysis of the otoliths and RNA/DNA condition analysis, which will be carried out as part of the Master thesis of L. Weidenauer. The rest of the plankton samples were conserved in formalin for later species- and size-composition analysis in the laboratory.

<u>Cod larvae</u>

Similar to our results from AL607 in January 2024, no cod larvae have been found in the Bongo 500 µm samples during AL607 in February 2024.

<u>Other fish larvae</u>

Despite larvae of cod, we also found a variety of other fish larvae such as for example flatfish larvae (i.e., plaice [*Pleuronectes platessa*] and flounder [*Platichthys flesus*]), larvae of hooknose (*Agonus cataphractus*), longspined bullhead (*Taurulus bubalis*), butterfish (*Pholis gunnellus*) or clupeids. In total we observed 293 larvae in the Bongo net 500 µm net samples over the 35 Bongo grid stations (Tab. 5.3.1; Fig. 5.3.1 to Fig. 5.3.7).

**Table 5.3.1.** Observed larvae, fish egg and gelatinous plankton counts from BONGO 500 µm net samples taken during AL607 in February 2024.

| Year | Month | Day | Cruise | Station | Haul | station name | *Gadus morhua* | Clupeid | *Pholis gunnellus* | *Pleuronectes platessa* | *Platichthys flesus* | *Limanda limanda* | *Taurulus bubalis* | other larvae | Cyanea | Ctenophora | Eggs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2024 | 2 | 10 | AL607 | 1-6 | 1 | GS1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 150 |
| 2024 | 2 | 10 | AL607 | 2-2 | 2 | GS2 | 0 | 0 | 3 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 120 |
| 2024 | 2 | 10 | AL607 | 3-1 | 3 | GS6 | 0 | 0 | 5 | 6 | 0 | 0 | 1 | 0 | 1 | 0 | 50 |
| 2024 | 2 | 10 | AL607 | 4-2 | 4 | GS7 | 0 | 0 | 1 | 6 | 0 | 0 | 3 | 1 | 0 | 0 | 50 |
| 2024 | 2 | 10 | AL607 | 5-1 | 5 | GS8 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 70 |
| 2024 | 2 | 10 | AL607 | 6-2 | 6 | GS9 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 70 |
| 2024 | 2 | 10 | AL607 | 7-1 | 7 | GS12 | 0 | 0 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 40 |
| 2024 | 2 | 10 | AL607 | 8-2 | 8 | GS13 | 0 | 0 | 3 | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 20 |
| 2024 | 2 | 10 | AL607 | 9-1 | 9 | GS14 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 40 |
| 2024 | 2 | 10 | AL607 | 10-2 | 10 | GS15 | 0 | 1 | 4 | 4 | 0 | 0 | 1 | 1 | 0 | 0 | 80 |
| 2024 | 2 | 11 | AL607 | 13-2 | 11 | GS17 | 0 | 2 | 6 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 30 |
| 2024 | 2 | 11 | AL607 | 14-1 | 12 | GS18 | 0 | 3 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 100 |
| 2024 | 2 | 11 | AL607 | 15-2 | 13 | GS19 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| 2024 | 2 | 13 | AL607 | 17-2 | 14 | GS33 | 0 | 1 | 1 | 0 | 0 | 0 | 9 | 1 | 0 | 0 | 40 |
| 2024 | 2 | 13 | AL607 | 18-1 | 15 | GS34 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 200 |
| 2024 | 2 | 13 | AL607 | 19-2 | 16 | GS35 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 10 |
| 2024 | 2 | 13 | AL607 | 20-1 | 17 | GS29 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 25 |
| 2024 | 2 | 13 | AL607 | 21-2 | 18 | GS28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| 2024 | 2 | 13 | AL607 | 22-1 | 19 | GS27 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 60 |
| 2024 | 2 | 13 | AL607 | 23-2 | 20 | GS30 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 40 |
| 2024 | 2 | 13 | AL607 | 24-1 | 21 | GS31 | 0 | 1 | 2 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 150 |
| 2024 | 2 | 13 | AL607 | 25-2 | 22 | GS32 | 0 | 3 | 1 | 1 | 0 | 0 | 6 | 1 | 0 | 0 | 150 |
| 2024 | 2 | 13 | AL607 | 26-1 | 23 | GS25 | 0 | 2 | 0 | 0 | 0 | 0 | 6 | 1 | 0 | 0 | 260 |
| 2024 | 2 | 13 | AL607 | 27-2 | 24 | GS24 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 250 |
| 2024 | 2 | 13 | AL607 | 28-1 | 25 | GS23 | 0 | 2 | 4 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 150 |
| 2024 | 2 | 13 | AL607 | 29-2 | 26 | GS22 | 0 | 1 | 3 | 1 | 0 | 0 | 2 | 3 | 0 | 0 | 200 |
| 2024 | 2 | 13 | AL607 | 30-1 | 27 | GS21 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 2 | 0 | 0 | 230 |
| 2024 | 2 | 13 | AL607 | 31-2 | 28 | GS26 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 150 |
| 2024 | 2 | 13 | AL607 | 32-1 | 29 | GS20 | 0 | 1 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 1 | 130 |
| 2024 | 2 | 14 | AL607 | 33-2 | 30 | GS16 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 110 |
| 2024 | 2 | 14 | AL607 | 34-1 | 31 | GS11 | 0 | 2 | 1 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 240 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2024 | 2 | 14 | AL607 | 35-2 | 32 | GS10 | 0 | 2 | 3 | 9 | 0 | 0 | 3 | 0 | 0 | 2 | 190 |
| 2024 | 2 | 14 | AL607 | 36-1 | 33 | GS5 | 0 | 1 | 7 | 1 5 | 0 | 0 | 2 | 0 | 0 | 0 | 320 |
| 2024 | 2 | 14 | AL607 | 37-2 | 34 | GS4 | 0 | 0 | 3 | 6 | 0 | 0 | 0 | 2 | 0 | 0 | 440 |
| 2024 | 2 | 14 | AL607 | 38-1 | 35 | GS3 | 0 | 0 | 6 | 7 | 0 | 0 | 2 | 0 | 0 | 0 | 150 |

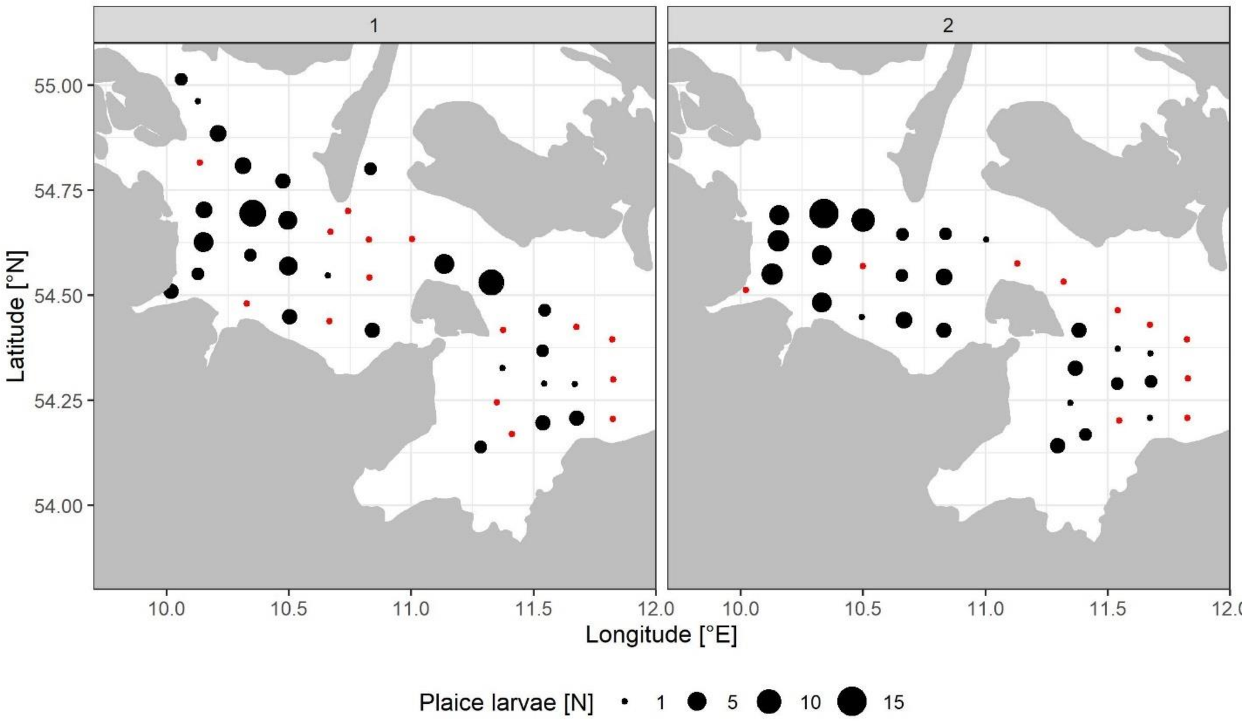


**Figure 5.3.1.** Total number of plaice (Pleuronectes platessa) larvae observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel). Red dots denote zero catches.

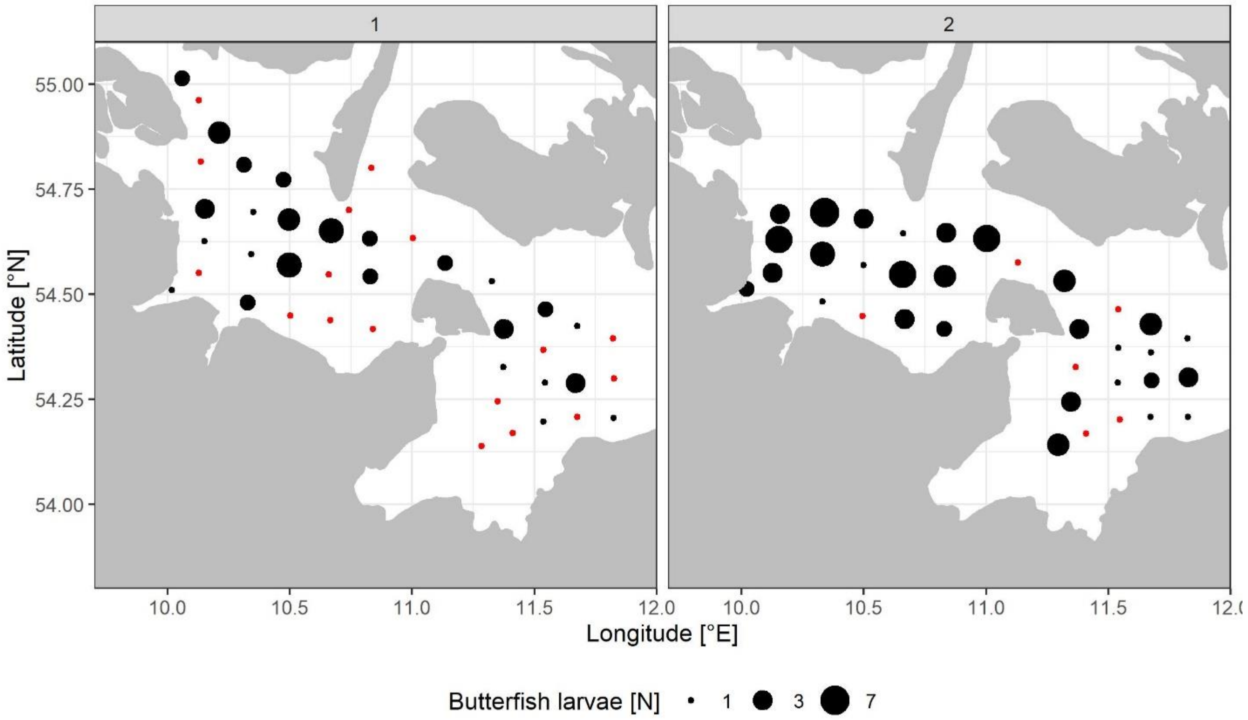


**Figure 5.3.2.** Total number of butterfish (*Pholis gunnellus*) larvae observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel). Red dots denote zero catches.

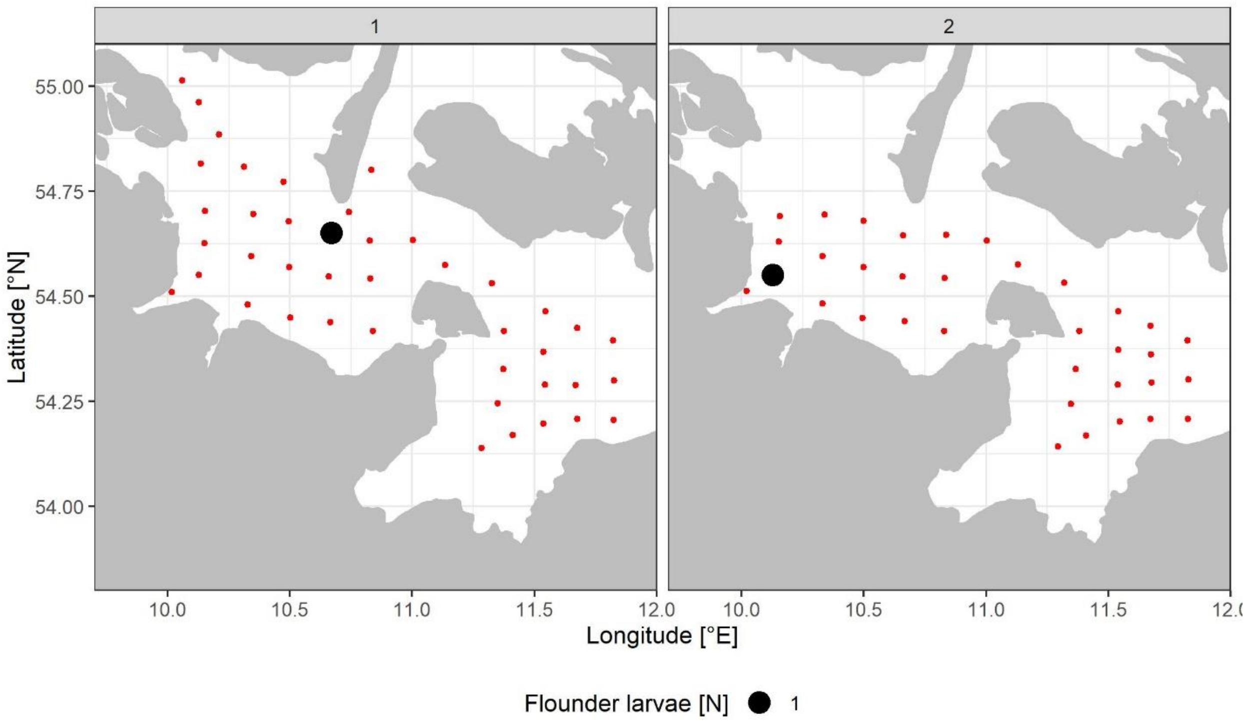


**Figure 5.3.3.** Total number of flounder (*Platichthys flesus*) larvae observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel). Red dots denote zero catches.

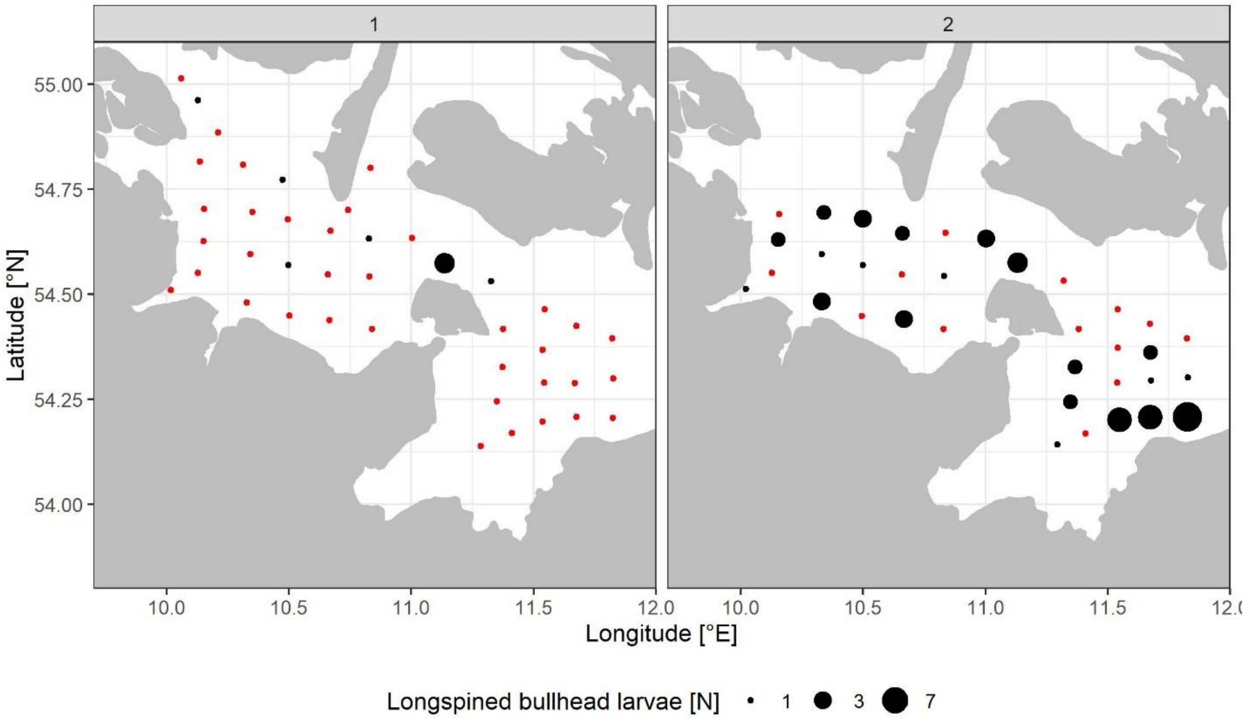


**Figure 5.3.4.** Total number of longspined bullhead (*Taurulus bubalis*) larvae observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel). Red dots denote zero catches.

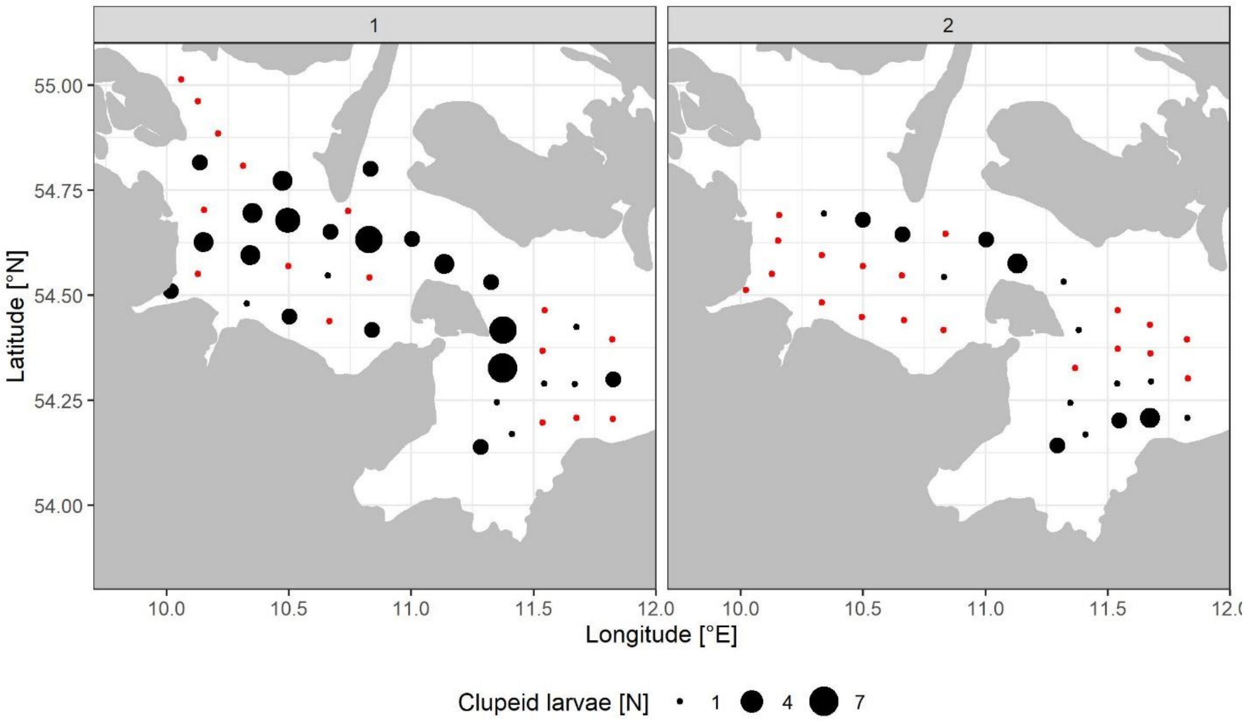


**Figure 5.3.5.** Total number of Clupeid larvae observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel). Red dots denote zero catches.

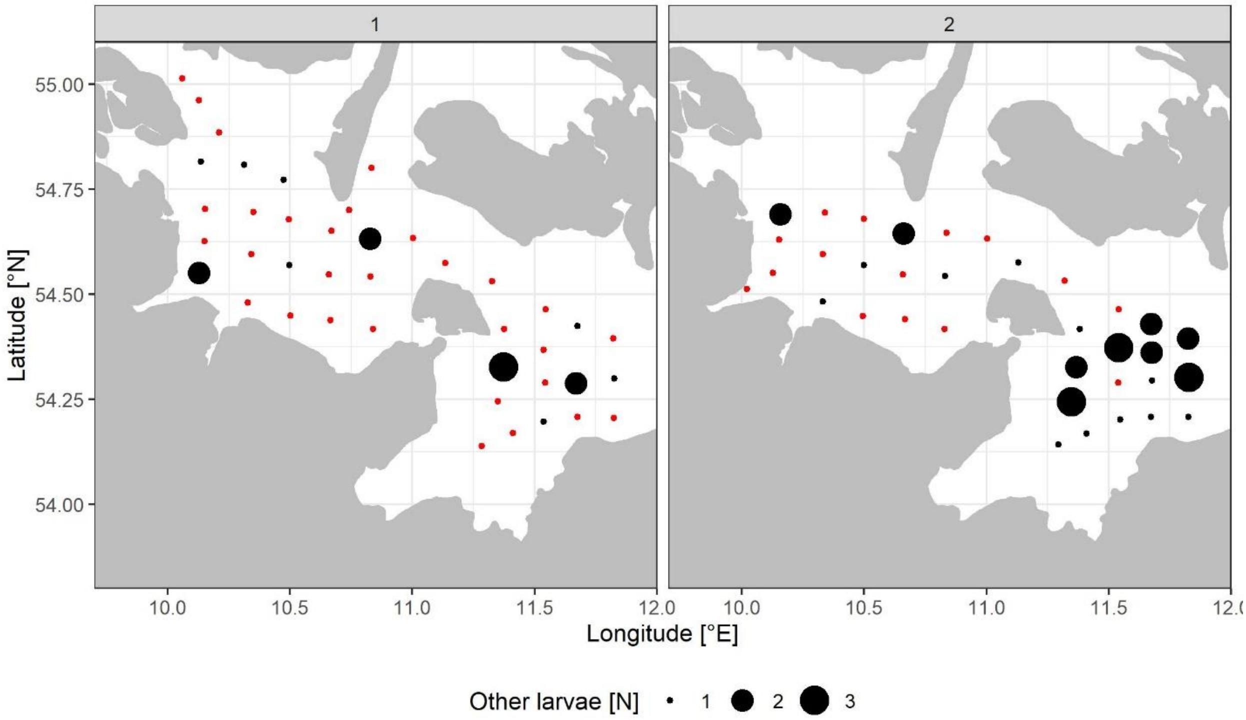


**Figure 5.3.6.** Total number of other larvae (including non-identified ones) observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel). Red dots denote zero catches.

Fish eggs

Number of fish eggs were counted in subsamples and then extrapolated to the total sample of BONGO 500 µm net hauls. Estimated number of observed fish eggs varied between 10 and 440. Maximum estimated number of fish eggs per station of 440 during AL607 was thus lower than the estimated maximum number recorded during AL606 with 600. Furthermore, we observed spatial differences in the distribution of eggs, with distinctly higher estimated total number of eggs per station in the Mecklenburg Bight during AL607 than during AL606 (Fig. 5.3.8).

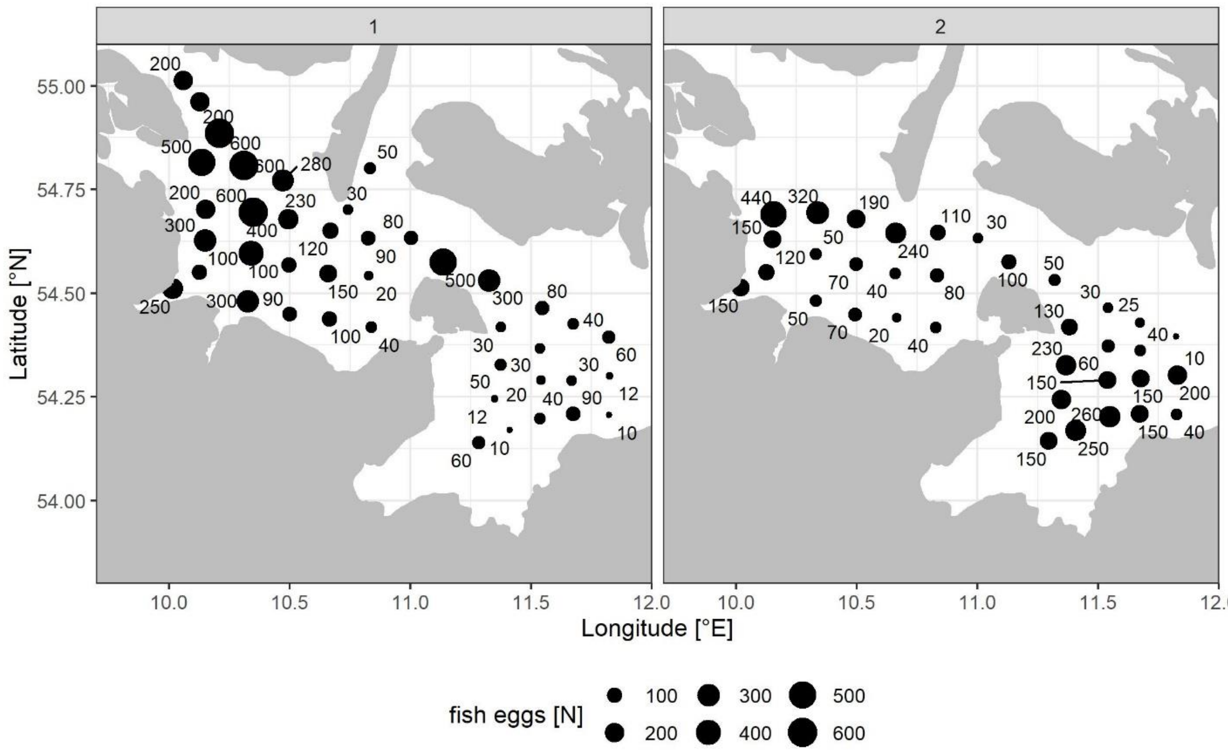

**Figure 5.3.7.** Total estimated number of fish eggs observed in BONGO 500 µm net samples during AL606 in January (left panel) and during AL607 in February (right panel).

## 6 Station List

In total 90 gear deployments were conducted during the cruise AL607 (see Tab. 6.2 for an overview per subarea and Tab. 6.1 for the full station list; Fig. 6.1). The electronic version of the station list as well as additional cruise data are permanently stored at the field data server of the Institute of Marine Ecosystem and Fisheries Science (IMF) of the University of Hamburg and are available on request. Furthermore, it is planned to make additional cruise data of AL607 (including for example station data, catch data and individual fish data of cod, as well as cod stomach content data) publicly available via the public data repository PANGEA (for further details see also section 7 “Data, Sample Storage and Availability” and Tab. 7.1.1).

**Table 6.1.1.** Station List with all gear deployments during AL607 with CTD = CTD probe, CTD_WS = CTD probe with water sampler BONGO = BONGO net with 300 and 500 µm nets, Bucket = Niskin bottle / water sampler, MN_S5 = multinet midi, Station AL607. = Station number, Depth = water depth at station.

| Station ALKOR | Device operation number | Device Operation Label | Event time | Latitude | Longitude | Depth [m] |
|---|---|---|---|---|---|---|
| AL607_1-1 | 1 | CTD | 10.02.2024 08:50 | 54° 30,797' N | 010° 01,173' E | 29 |
| AL607_1-2 | 2 | APNET | 10.02.2024 09:15 | 54° 30,822' N | 010° 01,156' E | 29 |
| AL607_1-3 | 3 | WP2 | 10.02.2024 09:27 | 54° 30,814' N | 010° 01,147' E | 29 |

| | | | | | | |
|---|---|---|---|---|---|---|
| AL607_1-4 | 4 | WP2 | 10.02.2024 09:34 | 54° 30,827' N | 010° 01,163' E | 29 |
| AL607_1-5 | 5 | BUCKET | 10.02.2024 09:43 | 54° 30,831' N | 010° 01,171' E | 29 |
| AL607_1-6 | 6 | BONGO | 10.02.2024 09:58 | 54° 30,777' N | 010° 01,191' E | 29 |
| AL607_2-1 | 1 | CTD | 10.02.2024 10:37 | 54° 33,017' N | 010° 07,459' E | 23 |
| AL607_2-2 | 2 | BONGO | 10.02.2024 10:46 | 54° 33,054' N | 010° 07,608' E | 23 |
| AL607_3-1 | 1 | BONGO | 10.02.2024 11:41 | 54° 35,692' N | 010° 19,866' E | 18 |
| AL607_3-2 | 2 | CTD | 10.02.2024 11:46 | 54° 35,708' N | 010° 20,058' E | 18 |
| AL607_4-1 | 1 | CTD | 10.02.2024 12:40 | 54° 28,924' N | 010° 19,829' E | 21 |
| AL607_4-2 | 2 | BONGO | 10.02.2024 12:44 | 54° 28,942' N | 010° 19,878' E | 21 |
| AL607_5-1 | 1 | BONGO | 10.02.2024 13:27 | 54° 26,915' N | 010° 29,627' E | 17 |
| AL607_5-2 | 2 | CTD | 10.02.2024 13:32 | 54° 26,944' N | 010° 29,901' E | 18 |
| AL607_6-1 | 1 | CTD | 10.02.2024 14:24 | 54° 34,158' N | 010° 29,895' E | 20 |
| AL607_6-2 | 2 | BONGO | 10.02.2024 14:28 | 54° 34,196' N | 010° 29,957' E | 20 |
| AL607_7-1 | 1 | BONGO | 10.02.2024 15:13 | 54° 32,862' N | 010° 39,567' E | 21 |
| AL607_7-2 | 2 | CTD | 10.02.2024 15:18 | 54° 32,928' N | 010° 39,813' E | 21 |
| AL607_8-1 | 1 | CTD | 10.02.2024 16:04 | 54° 26,434' N | 010° 40,012' E | 20 |
| AL607_8-2 | 2 | BONGO | 10.02.2024 16:07 | 54° 26,468' N | 010° 40,054' E | 20 |
| AL607_9-1 | 1 | BONGO | 10.02.2024 16:50 | 54° 25,006' N | 010° 49,743' E | 14 |
| AL607_9-2 | 2 | CTD | 10.02.2024 16:54 | 54° 25,011' N | 010° 49,948' E | 13 |
| AL607_10-1 | 1 | CTD | 10.02.2024 17:57 | 54° 32,669' N | 010° 49,955' E | 23 |
| AL607_10-2 | 2 | BONGO | 10.02.2024 18:02 | 54° 32,632' N | 010° 49,901' E | 22 |
| AL607_11-1 | 1 | CTD | 11.02.2024 06:59 | 54° 30,650' N | 010° 00,412' E | 30 |
| AL607_12-1 | 1 | BT | 11.02.2024 11:01 | 54° 31,389' N | 010° 03,390' E | 28 |
| AL607_13-1 | 1 | CTD | 11.02.2024 18:32 | 54° 37,945' N | 010° 59,986' E | 21 |
| AL607_13-2 | 2 | BONGO | 11.02.2024 18:37 | 54° 37,956' N | 011° 00,140' E | 21 |
| AL607_14-1 | 1 | BONGO | 11.02.2024 19:20 | 54° 34,546' N | 011° 07,851' E | 29 |
| AL607_14-2 | 2 | CTD | 11.02.2024 19:28 | 54° 34,554' N | 011° 08,285' E | 29 |
| AL607_15-1 | 1 | CTD | 11.02.2024 20:25 | 54° 31,930' N | 011° 19,178' E | 32 |
| AL607_15-2 | 2 | BONGO | 11.02.2024 20:30 | 54° 31,937' N | 011° 19,180' E | 32 |
| AL607_16-1 | 1 | CTD | 12.02.2024 07:03 | 54° 20,799' N | 011° 32,323' E | 26 |
| AL607_16-2 | 2 | BT | 12.02.2024 07:15 | 54° 20,902' N | 011° 32,251' E | 26 |
| AL607_16-3 | 3 | CTD | 12.02.2024 10:20 | 54° 20,891' N | 011° 32,347' E | 26 |
| AL607_16-4 | 4 | MN_S5 | 12.02.2024 10:36 | 54° 21,007' N | 011° 33,070' E | 26 |
| AL607_17-1 | 1 | CTD | 13.02.2024 08:39 | 54° 12,507' N | 011° 49,671' E | 22 |
| AL607_17-2 | 2 | BONGO | 13.02.2024 08:45 | 54° 12,491' N | 011° 49,598' E | 22 |
| AL607_18-1 | 1 | BONGO | 13.02.2024 09:22 | 54° 18,179' N | 011° 49,667' E | 24 |
| AL607_18-2 | 2 | CTD | 13.02.2024 09:27 | 54° 17,999' N | 011° 49,601' E | 24 |
| AL607_18-3 | 3 | CTD_WS | 13.02.2024 09:32 | 54° 17,968' N | 011° 49,585' E | 24 |
| AL607_19-1 | 1 | CTD | 13.02.2024 10:10 | 54° 23,798' N | 011° 49,485' E | 22 |
| AL607_19-2 | 2 | BONGO | 13.02.2024 10:14 | 54° 23,736' N | 011° 49,441' E | 22 |
| AL607_20-1 | 1 | BONGO | 13.02.2024 10:51 | 54° 25,771' N | 011° 40,374' E | 25 |
| AL607_20-2 | 2 | CTD | 13.02.2024 10:57 | 54° 25,570' N | 011° 40,451' E | 25 |
| AL607_21-1 | 1 | CTD | 13.02.2024 11:34 | 54° 27,902' N | 011° 32,440' E | 26 |

| | | | | | | |
|---|---|---|---|---|---|---|
| AL607_21-2 | 2 | BONGO | 13.02.2024 11:38 | 54° 27,847' N | 011° 32,515' E | 26 |
| AL607_22-1 | 1 | BONGO | 13.02.2024 12:17 | 54° 22,360' N | 011° 32,527' E | 25 |
| AL607_22-2 | 2 | CTD | 13.02.2024 12:22 | 54° 22,193' N | 011° 32,497' E | 25 |
| AL607_23-1 | 1 | CTD | 13.02.2024 12:54 | 54° 21,730' N | 011° 40,512' E | 26 |
| AL607_23-2 | 2 | BONGO | 13.02.2024 12:58 | 54° 21,687' N | 011° 40,527' E | 26 |
| AL607_24-1 | 1 | BONGO | 13.02.2024 13:25 | 54° 17,670' N | 011° 40,675' E | 26 |
| AL607_24-2 | 2 | CTD | 13.02.2024 13:30 | 54° 17,499' N | 011° 40,502' E | 26 |
| AL607_25-1 | 1 | CTD | 13.02.2024 14:03 | 54° 12,525' N | 011° 40,525' E | 26 |
| AL607_25-2 | 2 | BONGO | 13.02.2024 14:07 | 54° 12,502' N | 011° 40,446' E | 26 |
| AL607_26-1 | 1 | BONGO | 13.02.2024 14:38 | 54° 12,153' N | 011° 32,886' E | 26 |
| AL607_26-2 | 2 | CTD | 13.02.2024 14:44 | 54° 11,984' N | 011° 32,609' E | 25 |
| AL607_27-1 | 1 | CTD | 13.02.2024 15:20 | 54° 10,189' N | 011° 24,574' E | 24 |
| AL607_27-2 | 2 | BONGO | 13.02.2024 15:25 | 54° 10,113' N | 011° 24,516' E | 24 |
| AL607_28-1 | 1 | BONGO | 13.02.2024 15:54 | 54° 08,602' N | 011° 17,728' E | 27 |
| AL607_28-2 | 2 | CTD | 13.02.2024 16:00 | 54° 08,446' N | 011° 17,422' E | 27 |
| AL607_29-1 | 1 | CTD | 13.02.2024 16:44 | 54° 14,654' N | 011° 20,914' E | 22 |
| AL607_29-2 | 2 | BONGO | 13.02.2024 16:48 | 54° 14,660' N | 011° 20,830' E | 22 |
| AL607_30-1 | 1 | BONGO | 13.02.2024 17:22 | 54° 19,611' N | 011° 22,029' E | 22 |
| AL607_30-2 | 2 | CTD | 13.02.2024 17:27 | 54° 19,776' N | 011° 22,096' E | 22 |
| AL607_31-1 | 1 | CTD | 13.02.2024 18:13 | 54° 17,399' N | 011° 32,445' E | 25 |
| AL607_31-2 | 2 | BONGO | 13.02.2024 18:18 | 54° 17,427' N | 011° 32,315' E | 25 |
| AL607_32-1 | 1 | BONGO | 13.02.2024 19:14 | 54° 25,060' N | 011° 22,942' E | 21 |
| AL607_32-2 | 2 | CTD | 13.02.2024 19:20 | 54° 25,222' N | 011° 22,685' E | 20 |
| AL607_33-1 | 1 | CTD | 14.02.2024 07:05 | 54° 38,837' N | 010° 50,238' E | 34 |
| AL607_33-2 | 2 | BONGO | 14.02.2024 07:11 | 54° 38,781' N | 010° 50,271' E | 35 |
| AL607_34-1 | 1 | BONGO | 14.02.2024 07:52 | 54° 38,699' N | 010° 39,693' E | 28 |
| AL607_34-2 | 2 | CTD | 14.02.2024 07:59 | 54° 38,931' N | 010° 39,515' E | 33 |
| AL607_35-1 | 1 | CTD | 14.02.2024 08:41 | 54° 40,797' N | 010° 29,956' E | 26 |
| AL607_35-2 | 2 | BONGO | 14.02.2024 08:46 | 54° 40,760' N | 010° 29,968' E | 25 |
| AL607_36-1 | 1 | BONGO | 14.02.2024 09:21 | 54° 41,650' N | 010° 20,338' E | 31 |
| AL607_36-2 | 2 | CTD | 14.02.2024 09:27 | 54° 41,730' N | 010° 20,783' E | 33 |
| AL607_37-1 | 1 | CTD | 14.02.2024 10:10 | 54° 41,371' N | 010° 09,395' E | 32 |
| AL607_37-2 | 2 | BONGO | 14.02.2024 10:15 | 54° 41,438' N | 010° 09,396' E | 32 |
| AL607_38-1 | 1 | BONGO | 14.02.2024 10:50 | 54° 37,780' N | 010° 09,111' E | 23 |
| AL607_38-2 | 2 | CTD | 14.02.2024 10:56 | 54° 37,675' N | 010° 09,430' E | 23 |
| AL607_39-1 | 1 | BT | 14.02.2024 11:36 | 54° 41,975' N | 010° 17,372' E | 29 |
| AL607_40-1 | 1 | CTD | 15.02.2024 06:55 | 54° 37,775' N | 010° 09,330' E | 23 |
| AL607_40-2 | 2 | WP2 | 15.02.2024 07:09 | 54° 37,790' N | 010° 09,319' E | 23 |
| AL607_40-3 | 3 | APNET | 15.02.2024 07:09 | 54° 37,790' N | 010° 09,320' E | 23 |
| AL607_40-4 | 4 | WP2 | 15.02.2024 07:17 | 54° 37,794' N | 010° 09,303' E | 23 |
| AL607_40-5 | 5 | MN_S5 | 15.02.2024 07:31 | 54° 37,699' N | 010° 09,372' E | 23 |
| AL607_40-6 | 6 | BUCKET | 15.02.2024 07:57 | 54° 37,799' N | 010° 09,314' E | 23 |
| AL607_40-7 | 7 | BUCKET | 15.02.2024 08:04 | 54° 37,782' N | 010° 09,329' E | 23 |

| | | | | | | |
|---|---|---|---|---|---|---|
| AL607_41-1 | 1 | BT | 15.02.2024 08:22 | 54° 38,008' N | 010° 07,794' E | 24 |

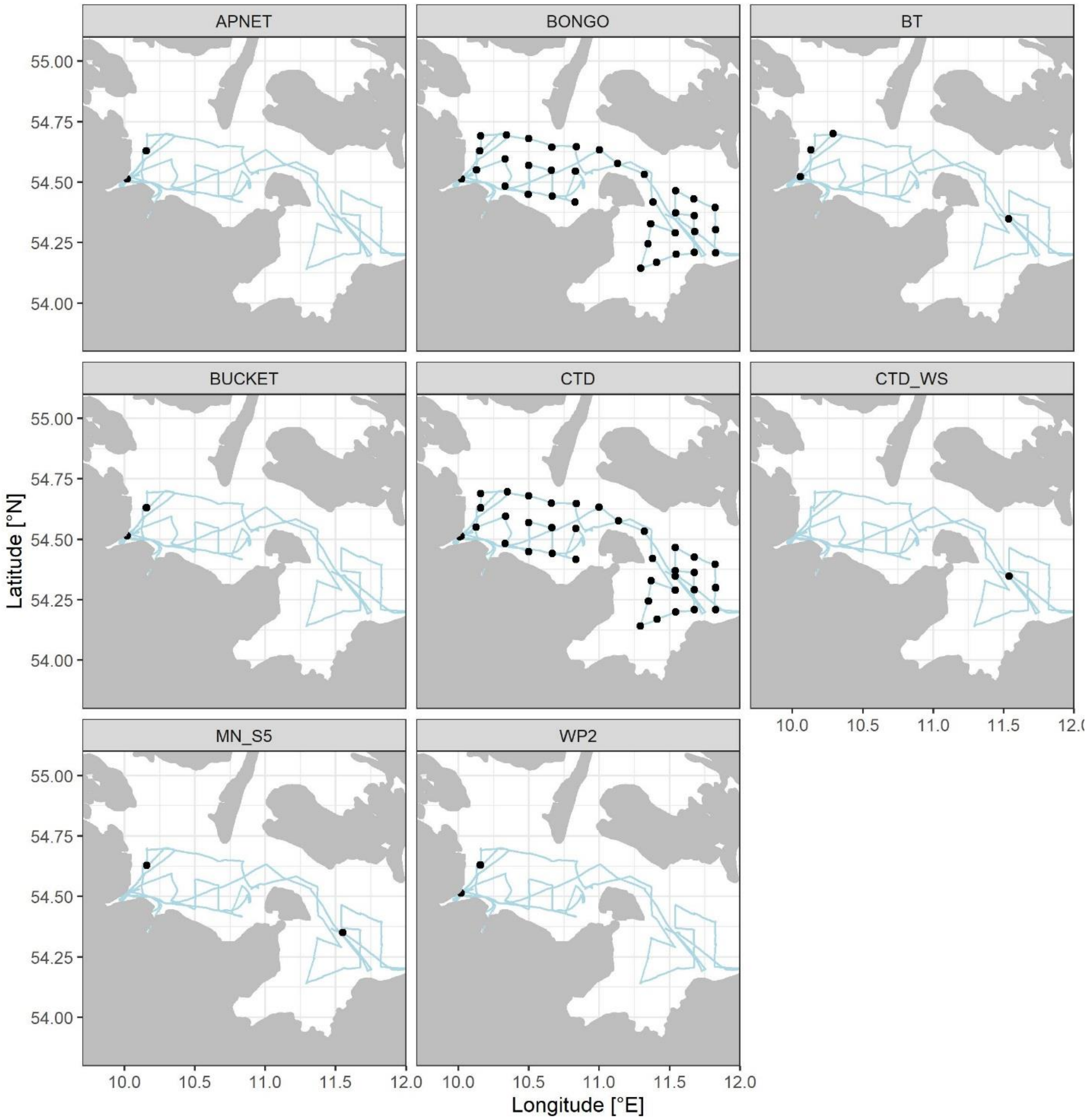


**Figure 6.1.** Cruise track and gear deployments during AL607. Sampling positions are indicated with black dots (APNET = Apstein net; BONGO = Bongo net; BT = Bottom trawl TV3/50, Bucket = water sampler/Niskin bottle, CTD = CTD probe, CTD_WS = CTD probe with water sampler; MN_S5 = Multinet midi towed; and WP2 = WP2 net).

**Table 6.2.** Overview of gear deployment during AL607. Numbers indicate number of deployments per gear (CTD = CTD probe, CTD_WS = CTD probe with water sampler, TV3/520= bottom trawl net, MN_S5 =

MULTINET midi towed, BONGO = BONGO with 300, and 500 µm nets, Bucket = Niskin bottle/ water sampler, Apstein = Apstein net, and WP2 = WP2 net) and sub-area (KB = Kiel Bight, FB, = Fehmarn Belt, and MB = Mecklenburg Bight).

| | **KB** | **FB** | **MB** | **Sum** |
|---|---|---|---|---|
| CTD | 18 | 3 | 17 | 39 |
| CTD_WS | 0 | 0 | 1 | 1 |
| BONGO | 16 | 3 | 16 | 35 |
| WP2 | 3 | 0 | 0 | 3 |
| Apstein | 3 | 0 | 0 | 3 |
| Bucket | 4 | 0 | 0 | 4 |
| MN_S5 | 1 | 0 | 1 | 2 |
| TV3/520 | 4 | 0 | 1 | 5 |

# 7 Data and Sample Storage and Availability

All data obtained during the cruise have been backed up on the field data server of the IMF of the University of Hamburg. In addition, data have been backed up and stored on different hard drives at different locations. Paper protocols filled out during the cruise were entered electronically and thus already felt under the back-up scheme, applied for the rest of the cruise data (including all cruise meta data such as the output of the onboard DSHIP-System). In addition, paper protocols were also conserved as hard copy at the IMF.

Furthermore, we aim to make all data obtained during the cruise AL607 publicly available. Hydrographic data (CTD) will be submitted to PANGEA (also planned to be uploaded on the ICES Oceanographic database) within one year from the cruise. Furthermore, it is planned to upload fishery data (including cod single fish data) in the public data repository PANGEA.

Depending on the data set, some of the data (especially including all zooplankton & ichthyoplankton data) are intended for specific publications. In the context of publication these data will be made publicly available. Right after analysing the taken cod stomach samples, stomach data will be added to the cod stomach data base of the IMF and Thuenen-OF.

All plankton samples obtained during the cruise AL607 and preserved in formalin were labelled directly on board using a barcoding scheme and were archived at the IMF. Please contact the responsible persons for a corresponding data set (see Tab. 7.1.1) if earlier access to the data is desired.

**Table 7.1.1.** Overview of data, data availability and corresponding contact persons (responsible for the specific data sets).

| Data | Database | Available | Free Access | Contact |
|---|---|---|---|---|
| Hydrography (CTD data) | PANGEA/ ICES database | Publicly by February 2025, earlier on request | By February 2025 | steffen.funk@uni-hamburg.de |
| Fishery data | PANGEA | Publicly by February 2025, earlier on request | By February 2025 | steffen.funk@uni-hamburg.de |
| Cod stomach content data | PANGEA | Publicly at time of publishing of the underlying peer-reviewed publication; | | steffen.funk@uni-hamburg.de |

| | | | | |
|---|---|---|---|---|
| | | earlier upon request (see contact) | | |
| Ichthyoplankton | PANGEA | Publicly at time of publishing of the underlying peer-reviewed publication; earlier upon request (see contact) | | christian.moellmann@uni-hamburg.de |
| Zooplankton | PANGEA | Publicly at time of publishing of the underlying peer-reviewed publication; earlier upon request (see contact) | | christian.moellmann@uni-hamburg.de |

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# 10 Abbreviations

BilSE – BilSE Institute (Institut für Bildung und Forschung)
BITS – Baltic international trawl survey
CeOS – Centre for Ocean and Society, Christian Albrechts-University of Kiel
DTU – Danish Technical University
ICES – International Council for the Exploration of the Sea
IMF – Institute of Marine Ecosystem and Fisheries Science
UHAM – University of Hamburg
Thuenen-OF – Thuenen Institute of Baltic Sea Fisheries Rostock
WBCF – Western Baltic cod Forum