ALKOR–Fahrtberichte

Biodiversity changes and their functional consequences in the pelagic ecosystems of the central Baltic Sea

Cruise-No. AL522

15 May – 30 May 2019,
Kiel (Germany) – Kiel (Germany)

Thorsten Reusch
GEOMAR Helmholtz Centre for Ocean Research Kiel
Research Division Marine Ecology/Marine Evolutionary Ecology

2019

Table of Contents

1 Cruise Summary

1.1 Summary in English

The AL522 cruise extended a 33yr long-term data series on (eco-)system composition and functioning of the Baltic Sea, with a focus on the deeper basins. A key characteristic of the cruise is the integration of oceanographic and biological information to enhance understanding of environmental and (fish) population fluctuations, and evolutionary processes in this system. The resulting data- and sample sets support ongoing projects in the Research Unit Marine Evolutionary Ecology at GEOMAR, as well as the EU Horizon 2020 project GoJelly and several international collaborations. The spatial focus lay on the Bornholm Basin as most important spawning area of Baltic cod, but also covered parts of the pronounced salinity gradient of the Baltic Sea and included the Western Baltic Sea, Arkona and Gotland Basin, Gdansk Deep, and Stolpe Trench.

Specific investigations included a detailed hydrological survey (oxygen, salinity, temperature) of the cruise area, plankton surveys (zoo- and ichthyoplankton including gelatinous plankton (jellyfish), with the goal to determine the composition and the abundance and vertical and horizontal distribution of species, and to take samples for later measurements of nutritional condition), and pelagic fishery hauls. The latter served to determine stock structure, gonadal maturation, stomach contents, and egg production of sprat and cod, and to sample tissue and otolith samples for individual-level genetic and ecological analyses of cod. The abundance and distribution of fishes in the cruise area was also assessed with hydroacoustic methods.

Additional cruise components were: (i) cod gonad and liver sampling for fecundity and parasite studies, (ii) vertically resolved plankton sampling for studies of plankton phenology (iii) depth-resolved sampling of microplastic using an neuston catamaran (iv) sampling and experimental work of photosynthesis rates of different phytoplankton fractions (v) eDNA filter sampling to compare with traditional net based methods.

Main preliminary results were that (i) bottom oxygen conditions in the main spawning ground of Eastern Baltic cod deteriorated during spring within 1 month to become anoxic (ii) cod nutritional condition seem to slightly improve, while the size structure of the stock is still very critical, with most individuals (>95%) smaller than 50 cm in length and (iii) moderate amounts of microplastic are present in the surface waters that await detailed verification and quantification.

1.2 Deutsche Zusammenfassung

Die AL522-Ausfahrt erweiterte eine 33-jährige Langzeitdatenreihe über das pelagische Ökosystem der zentralen Ostsee, mit einem Schwerpunkt auf den tieferen Becken. Ein wesentliches Merkmal der Kreuzfahrt ist die Integration ozeanographischer und biologischer Informationen, um das Verständnis von Umwelt- und (Fisch-)Bevölkerungsschwankungen und evolutionären Prozessen in diesem System zu verbessern. Die daraus resultierenden Daten- und Stichprobensätze unterstützen laufende Projekte in der Forschungseinheit „Marine Evolutionsökologie am GEOMAR sowie das EU Horizon 2020 Projekt GoJelly und mehrere internationale Kooperationen. Der räumliche Fokus lag auf dem Bornholm-Becken als wichtigstem Laichgebiet des Ostseedorschs, aber erfasste auch den ausgeprägten Salzgehaltsgradienten der Ostsee und umfasste die westliche Ostsee, das Arkona- und Gotlandbecken, das Danziger Tief und die Stolper Rinne.

Zu den spezifischen Untersuchungen gehörten eine detaillierte hydrologische Untersuchung (Sauerstoff, Salzgehalt, Temperatur) des Fahrtgebietes, Planktonuntersuchungen (Zoo- und Ichthyoplankton einschließlich gelatinösem Plankton (Quallen) mit dem Ziel, die Zusammensetzung und den Artenreichtum sowie die vertikale und horizontale Verteilung der Arten zu bestimmen und Proben für spätere Messungen des Ernährungszustandes zu entnehmen) und pelagische Fischereihols. Letzteres diente zur Bestimmung der Bestandsstruktur, der Gonadenreifung, des Mageninhalts und der Eierproduktion von Sprotte und Kabeljau sowie zur Probenahme von Gewebe- und Otolithenproben für genetische und ökologische Analysen auf individueller Ebene. Auch die Häufigkeit und Verteilung der Fische im Fahrtgebiet wurde mit hydroakustischen Methoden bewertet.

Weitere wissenschaftliche Ziele waren: (i) Kabeljau-Gonaden- und Leberproben für Fruchtbarkeits- und Parasitenstudien, (ii) vertikal aufgelöste Planktonproben für Studien der Planktonphänologie, (iii) tiefenaufgelöste Probenahme von Mikroplastik mit einem Neustonkatamaran, (iv) Probenahme und experimentelle Arbeit mit Photosyntheseraten verschiedener Phytoplanktonfraktionen, (v) eDNA-Filterprobenahme im Vergleich zu herkömmlichen netzbasierten Methoden.

Die wichtigsten vorläufigen Ergebnisse waren, dass sich (i) die Boden-Sauerstoffbedingungen im Hauptlaichgebiet des östlichen Dorschbestandes im Frühjahr innerhalb eines Monats drastisch verschlechtert haben, um anoxisch zu werden, (ii) sich der Ernährungszustand des Dorsches leicht zu verbessern scheint, während die Größenstruktur des Bestands immer noch sehr kritisch ist, wobei die meisten Individuen (>95%) kleiner als 50 cm lang sind und (iii) moderate Mengen an Mikroplastik an der Oberfläche gefunden wurde, die auf eine detaillierte Überprüfung und Quantifizierung warten.

2 Participants

2.1 Scientific Party

Name	Discipline	Institution[1]
Thorsten Reusch	Marine Evolutionary Ecology (Chief Scientist)	GEOMAR
Svend Mees	Technician	GEOMAR
Tatjana Liese	Biological Oceanography/ MSc Student	GEOMAR
Grace Walls	Biological Oceanography/MSc Student	GEOMAR
Eva Rohlfer	Biological Oceanography/MSc Student	GEOMAR
Erik Borchert	Microbiology/postdoc	GEOMAR
Fabian Wittmers[3]	Microbiology/postdoc	GEOMAR
Luisa Listmann	Marine Evolutionary Ecology/Postdoc	UHAM
Elisa Schaum[3]	Marine Evolutionary Ecology/professor	UHAM
Richard Klinger	Fisheries Science/MSc Student	UHAM
Dörte Müller-Navarra[2]	Ecology/Scientist	UHAM
Christian Pawlitzki	Biology/BSc Student	CAU
Katarzyna Spich	Observer	NMFRI
Erik Borchert	Microbiology/postdoc	GEOMAR

[1]Abbreviations explained under Section 2.2.

[2]First cruise leg Kiel - Rönne.

[3]Second cruise leg Rönne - Kiel.

2.2 Participating Institutions

Abbreviation	Full name
GEOMAR	Helmholtz-Centre for Ocean Research Kiel, Germany
CAU	Christian-Albrechts-Universität zu Kiel, Germany
UHAM	University of Hamburg
SDU	University of Southern Denmark
NMFRI	National Marine Fisheries Research Institute, Poland

3 Research Program (including Work Area, Aims and Agenda)

Although the Baltic Sea, and in particular its central parts, is species poor, it nevertheless provides ecosystems services to the Baltic nations in terms of primary productivity and harvestable fish stocks. Understanding the interactions among major ecosystem components such as fish and their major prey, zooplankton on the one hand, and climatic forcing impinging on these populations, such as salinity, oxygen supply and climate forcing on the other, is the central research question of the ALKOR May (and April) cruise. At the same time, the central Baltic Sea is one of the systems most affected by the combination of global (including climate) and local anthropogenic changes, and has undergone strong hydrographic and biological shifts in the past decades, which is why novel anthropogenic perturbations such as microplastic have been added to the sampling program.

Cruise AL522 is part of a 33-year effort to collect long-term data series on hydrography, zooplankton and fish species composition along the salinity gradient of the Baltic Sea, with an emphasis on the central Baltic Sea, dating back to 1987 by the GEOMAR Helmholtz Centre for Ocean Research and its predecessors IFM-GEOMAR Kiel and IFM Kiel. The rationale for the specific spatial focus “Bornholm Basin” results from its growing importance as the only major remaining spawning area of Eastern Baltic cod. However, the cruise also included the western Baltic Sea, Arkona and Gotland Basin and Gdansk Deep (Figure 3.1), thus covering ICES subdivisions (SD) 22, 24, 25, 26 and 28 (Figure 3.2).

The cruise integrated oceanographic and biological sampling, permitting a later time series analysis as to how Baltic pelagic food webs and (fish) species across the environmental gradients of the Baltic Sea change in response to both, environmental forcing and human exploitation. Data sets and samples obtained during cruise AL522 are essential for a number of projects, including the large-scale international project EU Horizon 2020 GoJelly and collaborations with the Technical University of Denmark, National Institute of Aquatic Resources (DTU Aqua), Stockholm University, and the University of Hamburg.

Figure 3.1 Cruise track of AL522

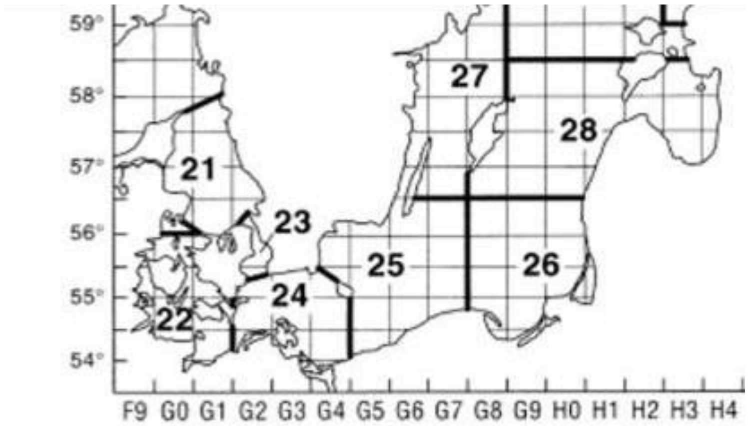

Figure 3.2 ICES subdivisions in the cruise area (Source: ICES). ICES SD22 corresponds to Kiel Bight = KB, SD24 to Arkona Basin = AB, SD25 to Bornholm Basin = BB and Stolpe Trench = SR, SD26 to Gdansk Deep = GD and Southern Gotland Basin (GB).

Specific investigations during AL522 included (1) a detailed hydrographic survey (oxygen, salinity, temperature) (2) zoo- and ichthyoplankton surveys to determine the composition, abundance, vertical and horizontal distribution and nutritional status of species as well as patterns of plankton phenology (3) sampling of important food web components including nutrients, seston, phyto-, zoo- (including jellyfish) and ichthyoplankton, (4) benthic and pelagic fishery hauls (5) eDNA assessments using filtered water samples (6) surface layer hauls with the newly constructed Neuston catamaran for sampling surface born microplastic.

Fisheries hauls served to determine size distributions, maturity status, and length – weight relationships of the three dominant fish species in the pelagic system of the Baltic, cod (*Gadus morhua*), herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) as well as flatfishes including flounder (*Plathichthys flesus*). Secondly, various samples for more detailed analyses back on land were obtained, including cod gonads, livers and otoliths, herring and sprat stomachs and whole samples for dietary analyses, and tissue samples of cod, flounder, whiting, plaice and other species for genetic and stable isotope analysis. In addition, hydroacoustic data were collected continuously along the cruise track for later analysis of fish abundance and distribution.

Additional work lines carried out in the context of collaborations with external groups included sampling and on-board experiments on photosynthesis and respiration rates of different phytoplankton fractions.

4 Narrative of the Cruise

RV ALKOR was loaded on the days prior to the onset of the cruise. ALKOR then departed from the GEOMAR Westshore pier on 15 May 2019 at 08:00 am (all times board time) and headed to the first research area in Kiel Bight (SD22). During AL522, all work laid out in the original cruise program was accomplished as planned, except for some minor delays when two small periods of stronger winds led to interruptions during passing Mecklenburg Bay (17 May) and the 2nd day in Bornholm Basin (25 May). Nevertheless, due to optimal allocation of ship time, and the perfect cooperation of the ship crew and the scientific team, the cruse ended one day early.

Over the course of the cruise, pelagic fishery hauls, zooplankton hauls with Bongo/IKS-80 nets, water sampler, and CTD hauls were carried out following a large-scale spatial sampling design covering Kiel Bight (SD22) on 15 May, Mecklenburg Bight (SD22) on 16 May, Arkona Basin on 17 May, Bornholm Basin (SD25) on 18 May and again in more detail from 21-29 May, Stolpe Trench (SD25) on 18 May, Gdansk Deep (SD26) on 19 May, and Gotland Basin (SD26) on 20 May (Figure 3.1, 3.2). Hydroacoustic data obtained with four different echosounder frequencies (38, 70, 120 and 200 kHz) were continuously recorded over the duration of the cruise.

The scientific work was interrupted by a scheduled harbor stay in Rönne, Bornholm on 23/24 May where some people of the scientific crew were exchanged.

As in previous years, the central deep station BB23 in Bornholm Basin was intensively sampled on two occasions, early in the cruise on 18 May (including CTD casts, zooplankton sampling with Bongo, Apstein and WP-2 nets, oxygen measurements of water samples obtained with the rosette water sampler with the Winkler method for the calibration of oxygen probe measurements, and phytoplankton sampling) and late in the cruise on 24/25 May (same sampling as on 18 May, followed by the detailed vertically and temporally resolved sampling of plankton communities by four towed Multinet MAXI and four vertical Multinet MIDI hauls over a 24 hour period, covering the water column in 5 m and 10 m depth layers, respectively). Moreover, whole food web samples (nutrients, seston, phyto- and zooplankton including jellyfish and fish larvae) were obtained at 4 stations, using a combination of water sampler, Bongo, WP-2 and WP-3 hauls. Additional sampling was carried out throughout the cruise area for the special projects on phytoplankton communities (surface water samples at 16 stations) and on eDNA assessments of pelagic fish and zooplankton compositions (4 stations). Table 4.1 provides a spatially resolved overview over all gear deployments during AL522. A newly tested gear was the Neuston-catamaran, a zooplankton sampler for the surface layer that, at the same time, was designed to sample possible microplastic contamination of Baltic Sea surface waters (Fig. 5.7.1)

Table 4.1 Overview of all gear deployments during AL522. Mesh sizes of all nets are given in brackets. For location designations are KB=Kiel Bay, MB= Mecklenburg Bay, AB=Arkona Basin, BB=Bornholm Basin, SR= Stolpe Trench, GD=Gdansk Deep, GB=Gotland Basin. Numbers designate the Baltic Sea subdivisions.

Count of gear	areas							
Row Labels	22 - KB	22 - MB	24 - AB	25 - BB	25 - SR	26 - GD	26 - GB	Grand Total
Apstein				3				3
Bo/BABo 150, 335, 500	3	2	18	48			3	74
CTD	3	2	19	51	2	10	5	92
IKS-80					2	10	5	17
JFT	1		2	5		3	2	13
MN-Maxi				10				10
MN-Midi				8				8
Neuston	1		2	4			2	9
WP2-100				3				3
WP2-200	1			2			2	5
WS-CTD	1		1	3			1	6
WS-Klein	2	2	3	6				13
WP3 1000	1							1
Grand Total	12	6	43	138	4	20	18	254

5 Preliminary Results

5.1 Ichthyo– and zooplankton sampling

Zooplankton samples were taken along the entire salinity gradient from Kiel Bight to Gotland Basin. A target area was the Bornholm Basin where the "Bongo-Grid" was taken, a quasi-synoptic survey of the entire basin on a grid spanning stations at 10 nm intervals. Bongo- and Baby-Bongo hauls covered Kiel Bight (5 hauls), Mecklenburg Bight (4 hauls), Arkona Basin (24 hauls), and Bornholm Basin including the western part of Stolpe Trench (53 hauls). Larvae of sprat (*Sprattus sprattus*; n = 681), flounder (*Plathichthys flesus*; n = 210), sculpin (*Myoxocephalus scorpius*, n = 2), common seasnail (*Liparis liparis*; n = 26) and sandeel

(*Ammodytes tobianus*; n = 22) were picked from the 500 µm bongo-samples and 300 µm Multinet samples and conserved at -80 °C for subsequent RNA/DNA, stable isotope and genetic analyses. As in the April cruise, a low number (n = 2) of cod (*Gadus morhua*) larvae was found which is consistent with the continual shift of the spawning period of Eastern Baltic cod stock towards later in the year (i.e, summer) (Fig. 5.1.1).

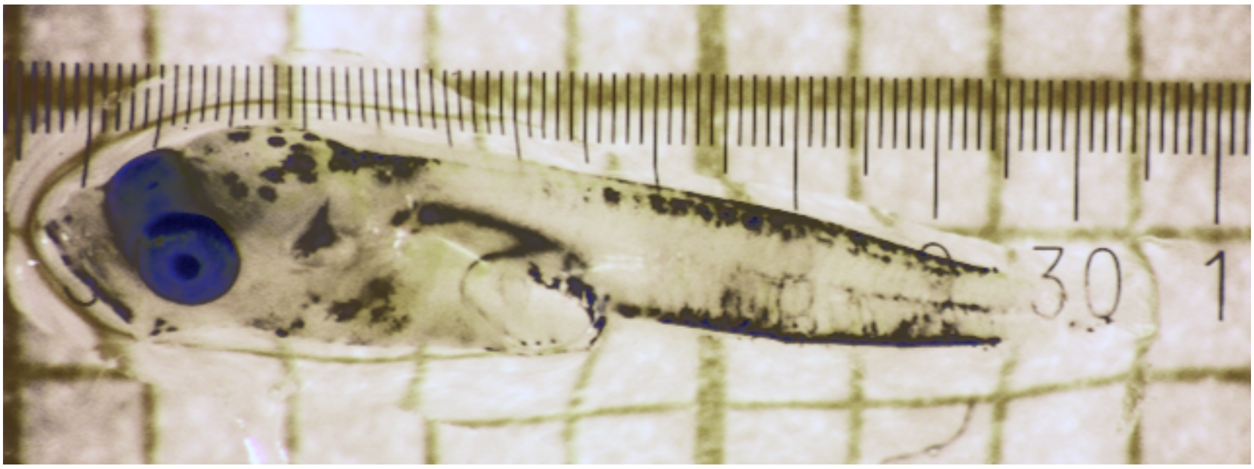

Fig. 5.1.1 One of 2 cod larvae caught in zooplankton hauls of AL522 and stored for later biochemical and genetic analyses.

All zooplankton net catches were checked for the presence of gelatinous zooplankton. Ephyrae (larvae) and small adults of scyphozoan jellyfish (identified on board as *Cyanea capillata,* potentially low numbers of *Aurelia aurita*) were present in much higher abundances than in May 2018, whereas the invasive comb jelly (Ctenophora) *Mnemiopsis leidyi* was entirely absent. A possible explanation are much higher water temperatures in 2019 compared to the same period in 2018, and possible effects on the phenology of gelatinous zooplankton. After removing fish larvae and jellyfish, all zooplankton catches samples were conserved in 4% buffered formalin solution in sweater for alter analysis, and are available for the determination of species composition and abundance of zoo- and ichthyoplankton throughout the 30yr time series.

Stations in the eastern part of Stolpe trench and in the Gdansk Deep and Southern Gotland Basin were sampled with IKS-80 nets instead of Bongo nets to ensure the compatibility of data with a long-term IKS-80 sampling series maintained by the Latvian Fish Resources Agency (LATFRA; Andrei Makarcuks).

At our key central Bornholm Basin station BB23 Multinet MAXI (300 µm, towed, sampling of the water column in 5 m layers) and MIDI (50 µm, vertical, sampling of the water column in 10 m layers) casts were performed over a one-day period on 25/26 May to assess diurnally resolved vertical distributions of ichthyo- and zooplankton. One of the first results is a markedly different depth distribution of small jellyfish, continually centered around 50-55 m water depth compared to the diel vertical migration of fish larvae (mainly sprat *Sprattus sprattus*) (Figure 5.1.2).

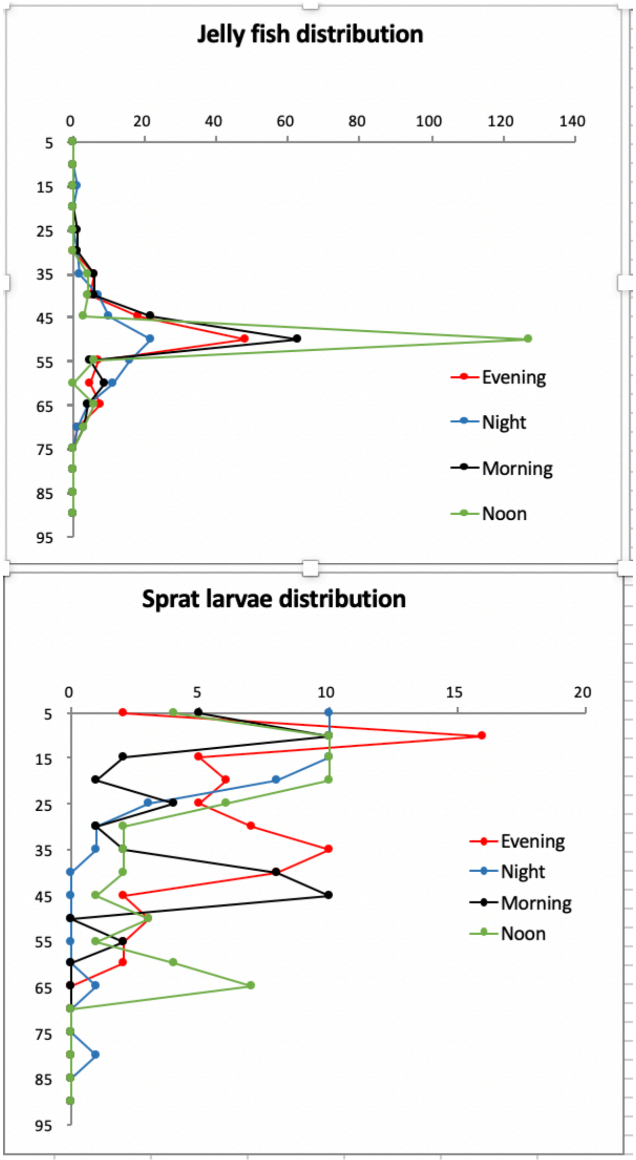

Figure 5.1.2 Depth resolved quantification of zooplankton and ichtyoplankton with the multi-net at Bornholm Basin station BB23. Top panel: Constant depth distribution of jellyfish ephyrae (mainly *Cyanea capillata*). **Bottom panel** sprat (*Sprattus sprattus*) larvae and their vertical migration movement from deeper layers closer to the surface during night over a 24-hour period on 25-26 May 2019.

5.2 Fishery

As oxygen conditions near the bottom were generally low to sustain higher life including fish at water depth >70m, most hauls (except those in Kiel and Mecklenburg Bay) were done within or slightly above the halocline, i.e. in the pelagic zone. Fishery hauls were conducted in Kiel Bight (1 haul), Mecklenburg Bight (1 haul) Arkona Basin (3 hauls), Bornholm Basin (5 hauls), Gotland Basin (3 hauls) and Gdansk Deep (3 hauls). The overall catch composition is shown in Table 5.2.1.

In the Arkona Basin, but also in western parts of the Bornholm basin, the whiting population seems to further increase in abundance compared to earlier years. Individualized samples of whiting (otoliths, fin clips for genetic analysis, gonads and livers) were taken from a total of 125 individuals, and of a further 346 were length /weight were recorded. For cod, single fish data (length, weight, sex and maturity stage) and samples (otoliths, fin clips for genetic analysis, gonads and livers) were obtained for 927 individuals in total. Length and weight were measured for additional individuals. On the positive side, the condition of animals, assessed as Fulton's K, slightly improved compared to previous years (Figure 5.2.1).

Table 5.2.1 Fish catch composition for AL522 of the topmost 6 abundant species. Single fish measurement and samples were taken for 927 cod and 219 whiting individuals. For herring and sprat, sub-samples were taken at each station. For flatfishes and all other species, measurements and fin clips of all individuals were taken.

Species	scientific name	N	total weight(kg)
Cod	*Gadus morhua*	923	331.431
Flounder	*Platichthys flesus*	23	3.986
Herring	*Clupea harengus*	1066	43.593
Plaice	*Pleuronectes platessa*	26	17.949
Sprat	*Sprattus sprattus*	130566	1237.917
Whiting	*Merlangius merlangus*	471	142.74
Grand Total		133086	1862.215

Also, in Bornholm Basin, the main spawning area of Baltic cod, the mean size of individuals has increased slightly from 32.9 cm in 2018 to 33.5 cm in May 2019 (Figure 5.2.2). However, the size structure in general is still not satisfactory, and larger individuals >50 cm, which were frequently observed in past decades, were mostly absent from the population. Both of these observations are consistent with temporal trends over past years. Further analyses will be directed towards what caused the apparent improvement, including a stable isotope analysis of the likely food items in the weeks prior to catch particular individuals.

Figure 5.2.1 Cod individuals were on average in better condition than in previous years, assessed as the ratio between weight and length (Fulton’s K), indicating that the nutritional situation has improved. An important downstream laboratory analysis will be as to whether and how the genetic structure has changed over time. The objective is here to identify possible gene loci that reveal signs of temporal selection for smaller sizes, i.e. fisheries induced evolution by means of full genome re-sequencing.

For sprat and herring, de tailed stock size structures were recorded for maximally 200 randomly picked individuals. For these planktonic zooplanktivorous species, stomach samples (sprat: 20 per 1 cm length class; herring: 20 per 2 cm length class) as well as 2 kg frost samples were taken at each fisheries station.

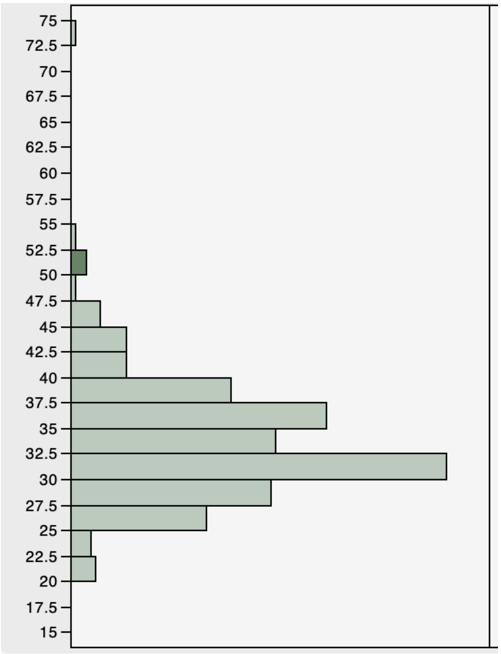

Figure 5.2.2 Cod individual size distribution (in cm standard length) in May 2019. Only 2.5% of individuals were >50 cm.

5.3 Hydrography

During AL 522, CTD profiles were obtained with the ADM-CTD at 102 stations and the rosette water sampler with attached CTD (14 stations). Two additional vertical oxygen profiles were obtained for calibration purposes at the deep central Bornholm Basin station BB23 by determining oxygen concentrations in depth resolved water samples taken with the water sampler using the Winkler method on 19 and 24 May.

Compared to early 2019 (cruise AL521 Ostsee "April"), oxygen concentrations in the deeper layers of Bornholm Basin but also Gdansk Deep had decreased considerably and were at 0 ml/l for most of the parts below the halocline in 70-75m depth in both, the Gotland and Bornholm basin. This rapid decay of oxygen influx within only a single month paralleled a similarly rapid decline observed in the April-May interval in 2018. Consequently, the fisheries had to be modified and the trawling happened 15-35m above bottom. Owing to these peculiar oxygen conditions, flatfish had to adopt a pelagic life style and were often caught in the free water column, in particular flounder, plaice and dab (Table 5.2.1). Together with 33 yrs of time series from previous ALKOR cruises, a detailed analysis is planned as to how quickly the oxygen content of oxygenated inflow is respired away, as a function of the rising water temperatures below the halocline that was observed in the past 2 decades. The combined observations of environmental parameters and the differences compared to the same time period in 2018 highlights that in order to make sense of the strong fluctuations in environmental conditions that are taking place in the Baltic Sea long-term observations over several decades are needed.

5.4 Food web structure of pelagic systems in the deep basins of the Baltic Sea (Dörte Müller-Navarra, EU Horizon 2020 project GoJelly)

In collaboration with the EU-funded GoJelly project, one cruise component was to assess the role of jellyfish in marine food webs, with a focus on the interactions between jellyfish and commercially important fish species. Here, the Baltic Sea is as one of several case study areas to address these topics, with other areas including Norwegian Fjords, Madeira in the North Atlantic and the eastern Mediterranean. Work during AL522 was a continuation of sampling efforts that took place during the ALKOR cruises AL507 and 509 in April and May 2018, as well as AL521 in Arial 2019 (see the respective cruise reports for details).

During AL522, three stations (KB06 in Kiel Bight, BB 23 in Bornholm Basin, and GB79 in Gotland Basin) were intensively sampled to obtain sample sets for subsequent laboratory analyses of fatty acid and stable isotope composition as food web markers. This included jellyfish ephyrae and small medusae, fish adults and larvae, and the main representatives of lower trophic levels (e.g., copepods, cladocerans). Additionally, phytoplankton and water samples were taken for chlorophyll, carbon to nitrogen ratios, bacteria and nutrient measurements.

5.5 Comparison of traditional net catches of zooplankton and fish species inventory to assessments using eDNA analysis (Thorsten Reusch, Marine Evolutionary Ecology at GEOMAR)

At four stations distributed along the salinity gradient of the Baltic Sea, three replicates of 2L of Niskin water samples from the surface layer and from below the halocline were filtered by gravity through a 0.4 um filter cassette and immediately deep frozen at -80°C. These samples will be DNA extracted later the year, subject to group specific PCR primers targeting the cytochrome oxidase I genes for crustaceans and for fish, respectively, and deep-sequenced using an Illumina MiSeq analyzer at the IKMB Kiel. The goal of this project will be to compare the species inventory obtained by eDNA to those captured by the zooplankton sampling (i.e. Bongo Nets) and the traditional fisheries using the JFT (pelagic trawl)

5.6 Marine microbes and viruses of the Baltic Sea under climate change (Luisa Listmann, Elisa Schaum, Hamburg University, in collaboration with the Research Unit Marine Evolutionary Ecology at GEOMAR)

As part of this project on the ecological and evolutionary effects of different temperatures and salinities in the Baltic Sea on phytoplankton, we aim to answer the following questions: a) Does the short-term physiological response of picoplankton to temperature and salinity differ between samples from different regions of the Baltic Sea? b) From which regions of the Baltic Sea can we isolate *Ostreococcus* sp. and its associated viruses?

To help answer these questions, we took surface water samples at 13 stations along the cruise track of AL522. On board, we measured photosynthesis and respiratory activity of two different size fractions (0.2-2 μm and 0.2-37.5 μm) immediately after sampling, and assessed these responses over a gradient of salinity and temperature. Furthermore, water samples of the smaller size fractions were set aside to isolate viruses and picoplankton back in the laboratory at the institute in Hamburg. The 16 stations were divided into Kiel Bay (2 station), Mecklenburg Bay (2 stations), the Arkona Basin (3 stations) and the Bornholm Basin (6 stations).

Preliminary analyses of the temperature curves show that the size fractions are similar in their metabolic activity, but point to differences between different regions along the salinity gradient of the Baltic Sea and the metabolic activities (i.e. GP and R). In-depth analyses are ongoing, and point toward regional environmental forcing (e.g. comparisons between Bornholm Basin and Kiel Bight) having an impact on par with that of seasonal forcing (e.g. comparisons between spring and summer). Our results suggest that while populations from either region can swiftly adjust their metabolic profiles along gradients of environmental change, the underlying mechanisms differ. For samples from the Bornholm Basin, rapid species sorting seems to explain most of the responses, whereas samples from Kiel Bight tend to respond to environmental change through sorting within the same species and phenotypic plasticity. In-depth analyses are ongoing. Further, we have had first lysis successes pointing toward the presence of lytic host-virus pairs across the Baltic Sea Basins.

5.7 **Assessing microplastic contamination of Baltic waters** (Eric Borchert, Grace Walls, Division of Marine Ecology at GEOMAR)

While for the Baltic Sea intense anthropogenic pressure has been documented, we know relatively little on the extent of pollution by plastic. A particular feature worth studying is the vertical stratification of salinity, which effectively creates a density gradient that may trap sinking plastic at a particular depth, corresponding to its density. Originally buoyant plastic may sediment out due to an accumulation of biofilms, becoming encapsulated within transparent exopolymer particles (TEP) or marine snow, or sink outright due to original density. We hypothesize that the strong halocline will act as a boundary to this sinking plastic and cause an accumulation of plastic to occur at depth. This causes the majority of plastic to be found at the surface and at the halocline, with less plastic being found in the depths between these zones. Annually a Maxi-MultiNet (Fig. 5.7.1) was used to collect a vertical profile of the water column in 5 m increments from 0-5m subsurface to 85-90m at the deepest depth. For the first time this year, a Neuston catamaran (Fig. 5.7.1) outfitted with a microplastic trawl net was used to sample the surface and subsurface of the water column (from 0-0.4 m depth) for buoyant plastic. The catamaran was towed starboard of the vessel outside of the wake to prevent any contamination from either the ship or the ships wake from effecting the sample. The catamaran was also equipped with a flowmeter to determine the volume of water filtered by the net. Within Bornholm Basin (station BB23) two Maxi-MultiNet tows were made to compare the surface/subsurface sample of the catamaran with the vertical profile from the Maxi-MultiNet. In addition to sampling the central Bornholm Basin station the catamaran was deployed throughout the Baltic to allow for a horizontal comparison of surface buoyant plastic. The samples were preserved in ethanol until further analysis of microplastic could take place upon returning to land. In addition to these samples 5 blanks of both the catamaran trawl and Maxi-MultiNet were collected along with several laboratory blanks to note the possible microfiber contamination caused by handling and sampling gear. These will also be analyzed upon returning to land to help separate contamination from collected samples.

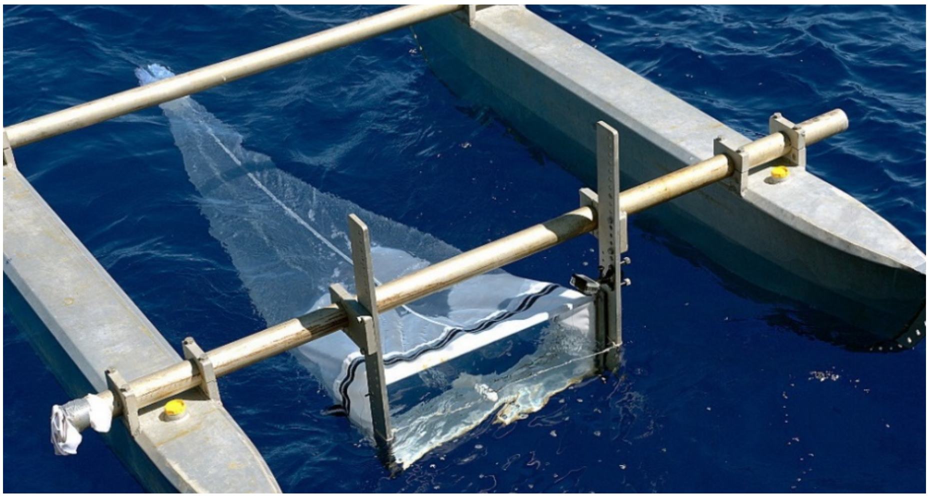

Figure 5.7.1. left: Neuston catamaran with Microplastic Trawl net. Right: Deployment of Maxi-MultiNet.

6 Station List

The list and additional cruise data are also permanently available via the GEOMAR OSIS data portal under the link: https://portal.geomar.de/metadata/cruise/show/348649

ship cruise ID	gear	gear nr	ship_station nr	yearx	month	quarter	date_start	time start	time end	number of day	Latitude	Longitude	bottom_depth_min	bottom_depth_max	SD	area	SD + area	station ID	Duration min
AL522	CTD	1	1	2019	5	2	15.05.19	12:37	12:40	135	544148	102039	25	25	22	KB	22 - KB	KB06	00:03
AL522	WS-Klein	1	1	2019	5	2	15.05.19	12:45	12:46	135	544149	102034	25	25	22	KB	22 - KB	KB06	00:01
AL522	JFT	1	1	2019	5	2	15.05.19	13:01	13:46	135	544153	102141	28		22	KB		KB06	00:45
AL522	CTD	2	2	2019	5	2	15.05.19	14:20	14:23	135	544096	103001	26	26	22	KB	22 - KB	KB12	00:03
AL522	Bo/BABo 150, 335, 500	1	2	2019	5	2	15.05.19	14:27	14:30	135	544095	102983	27	27	22	KB	22 - KB	KB12	00:03
AL522	Bo/BABo 150, 335, 500	2	3	2019	5	2	15.05.19	15:01	15:04	135	544148	102077	19	19	22	KB	22 - KB	KB06	00:03
AL522	WS-CTD	1	3	2019	5	2	15.05.19	15:17	15:22	135	544145	102032	25	25	22	KB	22 - KB	KB06	00:05
AL522	Neuston	1	3	2019	5	2	15.05.19	17:45	18:10	135	544148	102045	25	25	22	KB	22 - KB	KB06	00:25
AL522	WP2-200	1	3	2019	5	2	15.05.19	18:23	18:28	135	544148	102035	25	25	22	KB	22 - KB	KB06	00:05
AL522	WP3 1000	1	3	2019	5	2	15.05.19	18:34	18:35	135	545146	102035	25	25	22	KB	22 - KB	KB06	00:01
AL522	Bo/BABo 150, 335, 500	3	3	2019	5	2	15.05.19	18:36	18:41	135	544144	102041	24	24	22	KB	22 - KB	KB06	00:05
AL522	WS-Klein	2	4	2019	5	2	15.05.19	20:11	20:12	135	543296	104047	20	20	22	KB	22 - KB	KBLL	00:01
AL522	CTD	3	4	2019	5	2	15.05.19	20:06	20:07	135	543295	104044	20	20	22	KB	22 - KB	KBLL	00:01
AL522	CTD	4	5	2019	5	2	16.05.19	07:31	07:33	136	541117	112741	23	23	22	MB	22 - MB	MB02	00:02
AL522	WS-Klein	3	5	2019	5	2	16.05.19	07:36	07:39	136	541117	112740	23	23	22	MB	22 - MB	MB02	00:03
AL522	Bo/BABo 150, 335, 500	4	5	2019	5	2	16.05.19	07:47	07:51	136	541129	112748	23	23	22	MB	22 - MB	MB02	00:04
AL522	JFT	2	5	2019	5	2	16.05.19			136					22	MB		MB02	00:00
AL522	Bo/BABo 150, 335, 500	5	6	2019	5	2	16.05.19	10:18	10:21	136	541678	114811	24	24	22	MB	22 - MB	MB01	00:03
AL522	WS-Klein	4	6	2019	5	2	16.05.19	10:24	10:25	136	541690	114827	24	24	22	MB	22 - MB	MB01	00:01
AL522	CTD	5	6	2019	5	2	16.05.19	10:30	10:33	136	541689	114819	24	24	22	MB	22 - MB	MB01	00:03
AL522	CTD	6	7	2019	5	2	16.05.19	12:09	12:11	136	542398	120997	21	21	24	AB	24 - AB	H31	00:02

AL522	Bo/BABo 150, 335, 500	6	7	2019	5	2	16.05.19	12:13	12:16	136	542401	120994	21	21	24	AB	24 - AB	H31	00:03
AL522	Bo/BABo 150, 335, 500	7	8	2019	5	2	17.05.19	07:29	07:32	137	543746	121586	18	18	24	AB	24 - AB	H30	00:03
AL522	CTD	7	8	2019	5	2	17.05.19	07:37	07:39	137	543760	121616	18	18	24	AB	24 - AB	H30	00:02
AL522	CTD	8	9	2019	5	2	17.05.19	08:39	08:41	137	544297	122943	18	18	24	AB	24 - AB	H29	00:02
AL522	Bo/BABo 150, 335, 500	8	9	2019	5	2	17.05.19	08:44	08:47	137	544303	122949	18	18	24	AB	24 - AB	H29	00:03
AL522	Bo/BABo 150, 335, 500	9	10	2019	5	2	17.05.19	09:37	09:39	137	544984	123668	16	16	24	AB	24 - AB	H28	00:02
AL522	CTD	9	10	2019	5	2	17.05.19	09:43	09:45	137	544997	123693	14	14	24	AB	24 - AB	H28	00:02
AL522	CTD	10	11	2019	5	2	17.05.19	10:34	10:36	137	545448	124747	27	27	24	AB	24 - AB	H27	00:02
AL522	WS-Klein	5	11	2019	5	2	17.05.19	10:40	10:41	137	545452	124749	27	27	24	AB	24 - AB	H27	00:01
AL522	Bo/BABo 150, 335, 500	10	11	2019	5	2	17.05.19	10:44	11:48	137	545461	124753	28	28	24	AB	24 - AB	H27	01:04
AL522	Bo/BABo 150, 335, 500	11	12	2019	5	2	17.05.19	11:56	12:02	137	545321	130453	43	43	24	AB	24 - AB	H23	00:06
AL522	CTD	11	12	2019	5	2	17.05.19	12:05	12:09	137	545348	130489	43	43	24	AB	24 - AB	H23	00:04
AL522	JFT	3	12	2019	5	2	17.05.19	12:25	12:55	137	545996	130554	43		24	AB		H23	00:30
AL522	CTD	12	13	2019	5	2	17.05.19	13:42	13:46	137	545746	131489	46	46	24	AB	24 - AB	H22	00:04
AL522	Bo/BABo 150, 335, 500	12	13	2019	5	2	17.05.19	13:49	13:55	137	545754	131497	46	46	24	AB	24 - AB	H22	00:06
AL522	Bo/BABo 150, 335, 500	13	14	2019	5	2	17.05.19	18:04	18:10	137	550380	131542	43	43	24	AB	24 - AB	H02	00:06
AL522	WS-Klein	6	14	2019	5	2	17.05.19	18:12	18:13	137	550398	131594	43	43	24	AB	24 - AB	H02	00:01
AL522	CTD	13	14	2019	5	2	17.05.19	18:19	18:23	137	550400	131594	43	43	24	AB	24 - AB	H02	00:04
AL522	CTD	14	15	2019	5	2	17.05.19	19:19	19:22	137	550693	132969	43	43	24	AB	24 - AB	H04	00:03
AL522	Bo/BABo 150, 335, 500	14	15	2019	5	2	17.05.19	19:26	19:33	137	550701	132982	43	43	24	AB	24 - AB	H04	00:07
AL522	Bo/BABo 150, 335, 500	15	16	2019	5	2	17.05.19	21:24	21:29	137	544681	132927	42	42	24	AB	24 - AB	H20	00:05
AL522	WS-Klein	7	16	2019	5	2	17.05.19	21:32	21:33	137	544693	132980	43	43	24	AB	24 - AB	H20	00:01
AL522	CTD	15	16	2019	5	2	17.05.19	21:38	21:41	137	544695	132984	42	42	24	AB	24 - AB	H20	00:03
AL522	CTD	16	17	2019	5	2	17.05.19	23:01	23:04	137	545643	134685	49	49	24	AB	24 - AB	H18	00:03
AL522	Bo/BABo 150, 335, 500	16	17	2019	5	2	17.05.19	23:09	23:15	137	545654	134693	46	46	24	AB	24 - AB	H18	00:06
AL522	Bo/BABo 150, 335, 500	17	18	2019	5	2	18.05.19	00:13	00:19	138	550668	134761	44	44	24	AB	24 - AB	H05	00:06

AL522	CTD	17	18	2019	5	2	18.05.19	00:00	00:27	138	550697	1134789	44	44	24	AB	24 - AB	H05	00:27
AL522	CTD	18	19	2019	5	2	18.05.19	01:17	01:20	138	550896	140197	44	44	24	AB	24 - AB	H06	00:03
AL522	Bo/BABo 150, 335, 500	18	19	2019	5	2	18.05.19	01:23	01:28	138	550900	140190	44	44	24	AB	24 - AB	H06	00:05
AL522	Bo/BABo 150, 335, 500	19	20	2019	5	2	18.05.19	02:18	02:23	138	550099	140107	46	46	24	AB	24 - AB	H17	00:05
AL522	CTD	19	20	2019	5	2	18.05.19	02:27	02:31	138	550105	140156	46	46	24	AB	24 - AB	H17	00:04
AL522	CTD	20	21	2019	5	2	18.05.19	08:35	08:42	138	551749	154502	95	95	25	BB	25 - BB	BB23	00:07
AL522	Bo/BABo 150, 335, 500	20	21	2019	5	2	18.05.19	08:46	09:01	138	551749	154506	95	95	25	BB	25 - BB	BB23	00:15
AL522	WS-CTD	2	21	2019	5	2	18.05.19	09:37	09:45	138	551745	154496	95	95	25	BB	25 - BB	BB23	00:08
AL522	Neuston	2	21	2019	5	2	18.05.19	09:50	10:02	138	551741	154511	95	95	25	BB	25 - BB	BB23	00:12
AL522	Neuston	3	21	2019	5	2	18.05.19	10:07	10:19	138	551772	154678	95	95	25	BB	25 - BB	BB23	00:12
AL522	Bo/BABo 150, 335, 500	21	21	2019	5	2	18.05.19	10:22	10:58	138	551752	154501	95	95	25	BB	25 - BB	BB23	00:36
AL522	Bo/BABo 150, 335, 500	22	21	2019	5	2	18.05.19	10:45	11:14	138	551751	154493	95	95	25	BB	25 - BB	BB23	00:29
AL522	WP2-200	2	21	2019	5	2	18.05.19	11:03	11:29	138	551750	154498	95	95	25	BB	25 - BB	BB23	00:26
AL522	WP2-200	3	21	2019	5	2	18.05.19	11:16	11:29	138	551750	154500	95	95	25	BB	25 - BB	BB23	00:13
AL522	WS-CTD	3	21	2019	5	2	18.05.19	12:12		138	551748	154502	95	95	25	BB	25 - BB	BB23	
AL522	IKS-80	1	22	2019	5	2	18.05.19	18:12		138	551502	173498	82	82	25	SR	25 - SR	SR49	
AL522	CTD	21	22	2019	5	2	18.05.19	18:24	18:31	138	551503	173500	82	82	25	SR	25 - SR	SR49	00:07
AL522	CTD	22	23	2019	5	2	18.05.19	19:38	19:43	138	551400	175495	63	63	25	SR	25 - SR	SR50	00:05
AL522	IKS-80	2	23	2019	5	2	18.05.19	19:45		138	551400	175502	63	63	25	SR	25 - SR	SR50	
AL522	IKS-80	3	24	2019	5	2	18.05.19	21:31		138	550899	182483	79	79	26	GD	26 - GD	GD56	
AL522	CTD	23	24	2019	5	2	18.05.19	21:40	21:46	138	550900	182487	79	79	26	GD	26 - GD	GD56	00:06
AL522	CTD	24	25	2019	5	2	18.05.19	22:59	23:05	138	545996	184102	92	92	26	GD	26 - GD	GD59a	00:06
AL522	IKS-80	4	25	2019	5	2	18.05.19	23:07	23:14	138	545996	184110	92	92	26	GD	26 - GD	GD59a	00:07
AL522	IKS-80	5	26	2019	5	2	19.05.19	00:10	00:19	139	545400	185405	98	98	26	GD	26 - GD	GD59	00:09
AL522	CTD	25	26	2019	5	2	19.05.19	00:21	00:27	139	545394	185402	98	98	26	GD	26 - GD	GD59	00:06
AL522	CTD	26	27	2019	5	2	19.05.19	01:20	01:27	139	544895	190793	103	103	26	GD	26 - GD	GD60	00:07

AL522	IKS-80	6	27	2019	5	2	19.05.19	01:30	01:38	139	544898	190796	103	103	26	GD	26 - GD	GD60	00:08
AL522	IKS-80	7	28	2019	5	2	19.05.19	02:25	02:33	139	544296	191699	98	98	26	GD	26 - GD	GD60a	00:08
AL522	CTD	27	28	2019	5	2	19.05.19	02:36	02:45	139	544297	191697	98	98	26	GD	26 - GD	GD60a	00:09
AL522	JFT	4	29	2019	5	2	19.05.19	07:48	08:18	139	543792	1913	84		26	GD		GD60a	00:30
AL522	JFT	5	30	2019	5	2	19.05.19	10:13	10:43	139	545384	1906	105		26	GD		GD63	00:30
AL522	CTD	28	31	2019	5	2	19.05.19	11:55	12:03	139	544297	191201	106	106	26	GD	26 - GD	GD63	00:08
AL522	IKS-80	8	31	2019	5	2	19.05.19	12:05	12:14	139	545396	191201	106	106	26	GD	26 - GD	GD63	00:09
AL522	IKS-80	9	32	2019	5	2	19.05.19	12:57	13:05	139	545999	190496	101	101	26	GD	26 - GD	GD58	00:08
AL522	CTD	29	32	2019	5	2	19.05.19	13:07	13:14	139	550000	190499	101	101	26	GD	26 - GD	GD58	00:07
AL522	CTD	30	33	2019	5	2	19.05.19	14:28	14:35	139	550996	184895	91	91	26	GD	26 - GD	GD57	00:07
AL522	IKS-80	10	33	2019	5	2	19.05.19	14:37	14:45	139	550994	184901	91	91	26	GD	26 - GD	GD57	00:08
AL522	IKS-80	11	34	2019	5	2	19.05.19	15:33	15:40	139	551499	183699	75	75	26	GD	26 - GD	GD83	00:07
AL522	CTD	31	34	2019	5	2	19.05.19	15:42	15:47	139	551496	183703	75	75	26	GD	26 - GD	GD83	00:05
AL522	CTD	32	35	2019	5	2	19.05.19	16:58	17:04	139	552295	181902	80	80	26	GD	26 - GD	GD71	00:06
AL522	IKS-80	12	35	2019	5	2	19.05.19	17:08	17:14	139	552296	181902	80	80	26	GD	26 - GD	GD71	00:06
AL522	IKS-80	13	36	2019	5	2	19.05.19	18:34	18:42	139	553692	181880	93	93	26	GB	26 - GB	GB72	00:08
AL522	CTD	33	36	2019	5	2	19.05.19	18:44	18:52	139	553695	181884	93	93	26	GB	26 - GB	GB72	00:08
AL522	CTD	34	37	2019	5	2	19.05.19	20:22	20:28	139	555292	181188	66	66	26	GB	26 - GB	GB82	00:06
AL522	IKS-80	14	37	2019	5	2	19.05.19	20:30	20:35	139	555296	181182	66	66	26	GB	26 - GB	GB82	00:05
AL522	Bo/BABo 150, 335, 500	23	38	2019	5	2	19.05.19	21:30	21:45	139	555495	182782	104	104	26	GB	26 - GB	GB81	00:15
AL522	IKS-80	15	38	2019	5	2	19.05.19	21:47	21:56	139	555407	182915	105	105	26	GB	26 - GB	GB81	00:09
AL522	CTD	35	38	2019	5	2	19.05.19	21:58	22:05	139	555503	182920	105	105	26	GB	26 - GB	GB81	00:07
AL522	CTD	36	39	2019	5	2	19.05.19	22:51	22:58	139	555505	184277	115	115	26	GB	26 - GB	GB80	00:07
AL522	IKS-80	16	40	2019	5	2	19.05.19	23:00	23:09	139	555705	184282	115	115	26	GB	26 - GB	GB80	00:09
AL522	IKS-80	17	40	2019	5	2	20.05.19	07:30	07:38	140	555701	190298	115	115	26	GB	26 - GB	GB79	00:08
AL522	CTD	37	41	2019	5	2	20.05.19	07:42	07:50	140	555700	190299	113	113	26	GB	26 - GB	GB79	00:08

AL522	WS-CTD	4	41	2019	5	2	20.05.19	07:54	08:05	140	575700	190300	114	114	26	GB	26 - GB	GB79	00:11
AL522	Neuston	4	41	2019	5	2	20.05.19	08:07	08:19	140	555700	190321	112	112	26	GB	26 - GB	GB79	00:12
AL522	Neuston	5	41	2019	5	2	20.05.19	08:24	08:35	140	555770	190414	113	113	26	GB	26 - GB	GB79	00:11
AL522	Bo/BABo 150, 335, 500	24	41	2019	5	2	20.05.19	08:42	09:02	140	555675	190272	110	110	26	GB	26 - GB	GB79	00:20
AL522	Bo/BABo 150, 335, 500	25	41	2019	5	2	20.05.19	09:09	09:25	140	555705	190127	111	111	26	GB	26 - GB	GB79	00:16
AL522	WP2-200	4	41	2019	5	2	20.05.19	09:30	09:43	140	555693	190307	112	112	26	GB	26 - GB	GB79	00:13
AL522	WP2-200	5	41	2019	5	2	20.05.19	09:46	10:00	140	555698	190319	113	113	26	GB	26 - GB	GB79	00:14
AL522	JFT	6	41	2019	5	2	20.05.19	12:17	13:02	140	55571	19011	112		26	GB		GB79	00:45
AL522	JFT	7	42	2019	5	2	20.05.19	13:38	14:08	140	55573	1856	112		26	GB		GB79	00:30
AL522	CTD	38	43	2019	5	2	21.05.19	07:13	07:19	141	553659	154923	73	73	25	BB	25 - BB	BB06	00:06
AL522	JFT	8	43	2019	5	2	21.05.19	07:40	08:10	141	55369	15507	73		25	BB		BB06	00:30
AL522	JFT	9	44	2019	5	2	21.05.19	09:14	09:44	141	55385	1601	73		25	BB		BB06	00:30
AL522	CTD	39	45	2019	5	2	21.05.19	12:47	12:53	141	551294	153582	94	94	25	BB	25 - BB	BB23	00:06
AL522	JFT	10	46	2019	5	2	21.05.19	13:07	13:37	141	551376	1535	94		25	BB		BB31	00:30
AL522	JFT	11	46	2019	5	2	21.05.19	15:16	15:46	141	550468	1531	73		25	BB		BB31	00:30
AL522	CTD	40	47	2019	5	2	22.05.19	07:29	07:35	142	550507	154435	89	89	25	BB	25 - BB	BB30	00:06
AL522	JFT	12	47	2019	5	2	22.05.19	08:18	08:48	142	550576	1543	90		25	BB		BB30	00:30
AL522	JFT	13	48	2019	5	2	22.05.19	11:33	12:03	142	544399	1523	68		25	BB		BB30	00:30
AL522	CTD	41	47	2019	5	2	22.05.19	12:24	12:29	142	544413	152011	67	67	25	BB	25 - BB	BB40	00:05
AL522	CTD	42	49	2019	5	2	24.05.19	14:02	14:08	144	550749	154501	89	89	25	BB	25 - BB	BB40	00:06
AL522	WS-Klein	8	49	2019	5	2	24.05.19	14:11	14:13	144	550748	154500	89	89	25	BB	25 - BB	BB30	00:02
AL522	Neuston	6	50	2019	5	2	24.05.19	15:21	15:33	144	551748	154500	95	95	25	BB	25 - BB	BB30	00:12
AL522	Neuston	7	50	2019	5	2	24.05.19	15:37	15:47	144	551662	154411	95	95	25	BB	25 - BB	BB23	00:10
AL522	MN-Midi	1	50	2019	5	2	24.05.19	16:01	16:12	144	551750	154500	95	95	25	BB	25 - BB	BB23	00:11
AL522	MN-Midi	2	50	2019	5	2	24.05.19	16:20	16:25	144	551750	154500	95	95	25	BB	25 - BB	BB23	00:05
AL522	MN-Maxi	1	50	2019	5	2	24.05.19	18:00	18:42	144	551733	154482	95	95	25	BB	25 - BB	BB23	00:42

AL522	MN-Maxi	2	50	2019	5	2	24.05.19	18:54		144	551583	154314	95	95	25	BB	25 - BB	BB23	
AL522	CTD	43	50	2019	5	2	24.05.19	15:12	15:18	144	551752	154505	95	95	25	BB	25 - BB	BB23	00:06
AL522	MN-Midi	3	50	2019	5	2	24.05.19	22:00	22:10	144	551756	154518	95	95	25	BB	25 - BB	BB23	00:10
AL522	MN-Midi	4	50	2019	5	2	24.05.19	22:15	22:33	144	551758	154510	95	95	25	BB	25 - BB	BB23	00:18
AL522	MN-Maxi	3	50	2019	5	2	25.05.19	00:00	00:39	145	551749	154505	95	95	25	BB	25 - BB	BB23	00:39
AL522	MN-Maxi	4	50	2019	5	2	25.05.19	00:53	01:26	145	551716	154191	95	95	25	BB	25 - BB	BB23	00:33
AL522	MN-Midi	5	50	2019	5	2	25.05.19	04:00	04:09	145	551749	154506	95	95	25	BB	25 - BB	BB23	00:09
AL522	MN-Midi	6	50	2019	5	2	25.05.19	04:21	04:28	145	551749	154506	95	95	25	BB	25 - BB	BB23	00:07
AL522	MN-Maxi	5	50	2019	5	2	25.05.19	06:00	06:38	145	551745	154517	95	95	25	BB	25 - BB	BB23	00:38
AL522	MN-Maxi	6	50	2019	5	2	25.05.19	06:50	07:26	145	551722	154171	95	95	25	BB	25 - BB	BB23	00:36
AL522	MN-Midi	7	50	2019	5	2	25.05.19	10:17	10:28	145	551750	154500	95	95	25	BB	25 - BB	BB23	00:11
AL522	MN-Midi	8	50	2019	5	2	25.05.19	10:31	10:40	145	551750	154501	95	95	25	BB	25 - BB	BB23	00:09
AL522	MN-Maxi	7	50	2019	5	2	25.05.19	12:00	12:38	145	551749	154505	95	95	25	BB	25 - BB	BB23	00:38
AL522	MN-Maxi	8	50	2019	5	2	25.05.19	12:51	13:24	145	551708	154196	95	95	25	BB	25 - BB	BB23	00:33
AL522	MN-Maxi	9	50	2019	5	2	25.05.19	13:36	14:05	145	551750	154508	95	95	25	BB	25 - BB	BB23	00:29
AL522	MN-Maxi	10	50	2019	5	2	25.05.19	14:15	14:44	145	551719	154282	95	95	25	BB	25 - BB	BB23	00:29
AL522	Apstein	1	50	2019	5	2	25.05.19	15:03	15:19	145	551750	154501	95	95	25	BB	25 - BB	BB23	00:16
AL522	Apstein	2	50	2019	5	2	25.05.19	15:24	15:36	145	551751	154200	95	95	25	BB	25 - BB	BB23	00:12
AL522	Apstein	3	50	2019	5	2	25.05.19	15:41	15:58	145	551748	154502	95	95	25	BB	25 - BB	BB23	00:17
AL522	WP2-100	1	50	2019	5	2	25.05.19	16:06	16:14	145	551747	154501	95	95	25	BB	25 - BB	BB23	00:08
AL522	WP2-100	2	50	2019	5	2	25.05.19	16:18	16:28	145	551748	154502	95	95	25	BB	25 - BB	BB23	00:10
AL522	WP2-100	3	50	2019	5	2	25.05.19	16:34	16:43	145	551749	154502	95	95	25	BB	25 - BB	BB23	00:09
AL522	WS-CTD	5	50	2019	5	2	25.05.19	18:00	18:16	145	551747	154496	95	95	25	BB	25 - BB	BB23	00:16
AL522	Bo/BABo 150, 335, 500	26	50	2019	5	2	25.05.19	18:43	19:00	145	551757	154510	95	95	25	BB	25 - BB	BB23	00:17
AL522	Bo/BABo 150, 335, 500	27	51	2019	5	2	25.05.19	19:41	19:54	145	551755	155902	90	90	25	BB	25 - BB	BB24	00:13
AL522	CTD	44	51	2019	5	2	25.05.19	19:59	20:04	145	551744	160006	89	89	25	BB	25 - BB	BB24	00:05

AL522	CTD	45	52	2019	5	2	25.05.19	20:53	20:59	145	55171	161498	74	74	25	BB	25 - BB	BB25	00:06
AL522	Bo/BABo 150, 335, 500	28	52	2019	5	2	25.05.19	21:01	21:11	145	551742	161489	74	74	25	BB	25 - BB	BB25	00:10
AL522	Bo/BABo 150, 335, 500	29	53	2019	5	2	25.05.19	22:13	22:22	145	552784	161574	74	74	25	BB	25 - BB	BB14	00:09
AL522	CTD	46	53	2019	5	2	25.05.19	22:31	22:36	145	552747	161507	74	74	25	BB	25 - BB	BB14	00:05
AL522	WS-Klein	9	53	2019	5	2	25.05.19	22:25	22:26	145	552747	161507	74	74	25	BB	25 - BB	BB14	00:01
AL522	CTD	47	54	2019	5	2	25.05.19	23:27	23:32	145	552753	160016	83	83	25	BB	25 - BB	BB15	00:05
AL522	Bo/BABo 150, 335, 500	30	54	2019	5	2	25.05.19	23:35	23:47	145	552746	160004	83	83	25	BB	25 - BB	BB15	00:12
AL522	Bo/BABo 150, 335, 500	31	55	2019	5	2	26.05.19	00:33	00:44	146	552773	154585	85	85	25	BB	25 - BB	BB16	00:11
AL522	CTD	48	55	2019	5	2	26.05.19	00:48	00:54	146	552747	154502	85	85	25	BB	25 - BB	BB16	00:06
AL522	CTD	49	56	2019	5	2	26.05.19	01:44	01:49	146	552750	153022	85	85	25	BB	25 - BB	BB17	00:05
AL522	Bo/BABo 150, 335, 500	32	56	2019	5	2	26.05.19	01:52	02:03	146	552742	152990	85	85	25	BB	25 - BB	BB17	00:11
AL522	Bo/BABo 150, 335, 500	33	57	2019	5	2	26.05.19	02:53	03:03	146	552765	151534	88	88	25	BB	25 - BB	BB18	00:10
AL522	CTD	50	57	2019	5	2	26.05.19	03:08	03:14	146	552741	151481	90	90	25	BB	25 - BB	BB18	00:06
AL522	CTD	51	58	2019	5	2	26.05.19	04:08	04:13	146	552754	150007	78	78	25	BB	25 - BB	BB19	00:05
AL522	Bo/BABo 150, 335, 500	37	58	2019	5	2	26.05.19	04:17	04:27	146	552749	145997	78	78	25	BB	25 - BB	BB19	00:10
AL522	Bo/BABo 150, 335, 500	35	59	2019	5	2	26.05.19	05:16	05:25	146	552778	144566	68	68	25	BB	25 - BB	BB01	00:09
AL522	CTD	52	59	2019	5	2	26.05.19	05:28	05:33	146	552752	144508	69	69	25	BB	25 - BB	BB01	00:05
AL522	CTD	53	60	2019	5	2	26.05.19	06:48	06:54	146	551752	145991	72	72	25	BB	25 - BB	BB20	00:06
AL522	WS-Klein	10	60	2019	5	2	26.05.19	06:57	06:59	146	551751	155919	72	72	25	BB	25 - BB	BB20	00:02
AL522	Bo/BABo 150, 335, 500	36	60	2019	5	2	26.05.19	07:01	07:13	146	551749	154988	71	71	25	BB	25 - BB	BB20	00:12
AL522	Bo/BABo 150, 335, 500	37	61	2019	5	2	26.05.19	08:14	08:25	146	551766	151824	91	91	25	BB	25 - BB	BB21	00:11
AL522	CTD	54	61	2019	5	2	26.05.19	08:30	08:35	146	551742	151729	90	90	25	BB	25 - BB	BB21	00:05
AL522	CTD	55	62	2019	5	2	26.05.19	09:18	09:24	146	551744	152993	93	93	25	BB	25 - BB	BB22	00:06
AL522	Bo/BABo 150, 335, 500	38	62	2019	5	2	26.05.19	09:27	09:38	146	551741	152982	93	93	25	BB	25 - BB	BB22	00:11
AL522	Bo/BABo 150, 335, 500	39	63	2019	5	2	26.05.19	10:59	11:09	146	550777	154585	88	88	25	BB	25 - BB	BB30	00:10
AL522	CTD	56	63	2019	5	2	26.05.19	11:14	11:20	146	550756	154527	88	88	25	BB	25 - BB	BB30	00:06

AL522	CTD	57	64	2019	5	2	26.05.19	12:17	12:22	146	550753	153007	67	67	25	BB	25 - BB	BB31	00:05
AL522	Bo/BABo 150, 335, 500	40	64	2019	5	2	26.05.19	12:25	12:34	146	550750	153005	67	67	25	BB	25 - BB	BB31	00:09
AL522	Bo/BABo 150, 335, 500	41	65	2019	5	2	26.05.19	13:25	13:32	146	550779	151535	61	61	25	BB	25 - BB	BB32	00:07
AL522	CTD	58	65	2019	5	2	26.05.19	13:40	13:44	146	550754	151504	61	61	25	BB	25 - BB	BB32	00:04
AL522	WS-Klein	11	65	2019	5	2	26.05.19	13:34	13:35	146	550754	151506	61	61	25	BB	25 - BB	BB32	00:01
AL522	CTD	59	66	2019	5	2	26.05.19	17:47	17:51	146	545758	151496	42	42	25	BB	25 - BB	BB33	00:04
AL522	Bo/BABo 150, 335, 500	42	66	2019	5	2	26.05.19	17:53	18:02	146	545751	151488	42	42	25	BB	25 - BB	BB33	00:09
AL522	Bo/BABo 150, 335, 500	43	67	2019	5	2	26.05.19	18:55:00	19:07	146	545788	153058	76	76	25	BB	25 - BB	BB34	00:12
AL522	CTD	60	67	2019	5	2	26.05.19	19:12	19:18	146	545737	152979	76	76	25	BB	25 - BB	BB34	00:06
AL522	CTD	61	68	2019	5	2	26.05.19	20:07	20:13	146	545748	154490	81	81	25	BB	25 - BB	BB35	00:06
AL522	Bo/BABo 150, 335, 500	44	68	2019	5	2	26.05.19	20:16	20:25	146	545739	154480	81	81	25	BB	25 - BB	BB35	00:09
AL522	Bo/BABo 150, 335, 500	45	69	2019	5	2	26.05.19	21:18	21:28	146	544809	154564	72	72	25	BB	25 - BB	BB39	00:10
AL522	CTD	62	69	2019	5	2	26.05.19	21:31	21:36	146	544763	154514	72	72	25	BB	25 - BB	BB39	00:05
AL522	CTD	63	70	2019	5	2	26.05.19	22:27	22:32	146	544749	153018	74	74	25	BB	25 - BB	BB40	00:05
AL522	Bo/BABo 150, 335, 500	46	70	2019	5	2	26.05.19	22:35	22:44	146	544740	153004	74	74	25	BB	25 - BB	BB40	00:09
AL522	Bo/BABo 150, 335, 500	47	71	2019	5	2	26.05.19	23:30	23:38	146	544795	151564	68	68	25	BB	25 - BB	BB41	00:08
AL522	CTD	64	71	2019	5	2	26.05.19	23:42	23:46	146	544754	151505	68	68	25	BB	25 - BB	BB41	00:04
AL522	CTD	65	72	2019	5	2	27.05.19	00:36	00:40	147	544752	150001	60	60	25	BB	25 - BB	BB42	00:04
AL522	Bo/BABo 150, 335, 500	48	72	2019	5	2	27.05.19	00:42	00:50	147	544747	150000	60	60	25	BB	25 - BB	BB42	00:08
AL522	Bo/BABo 150, 335, 500	49	73	2019	5	2	27.05.19	02:02	02:09	147	543782	151532	59	59	25	BB	25 - BB	BB43	00:07
AL522	CTD	66	73	2019	5	2	27.05.19	02:14	02:19	147	543756	151496	58	58	25	BB	25 - BB	BB43	00:05
AL522	CTD	67	74	2019	5	2	27.05.19	03:11	03:15	147	543779	153038	63	63	25	BB	25 - BB	BB44	00:04
AL522	Bo/BABo 150, 335, 500	50	74	2019	5	2	27.05.19	03:18	03:25	147	543773	153038	63	63	25	BB	25 - BB	BB44	00:07
AL522	Bo/BABo 150, 335, 500	51	75	2019	5	2	27.05.19	04:14	04:25	147	543781	154532	59	59	25	BB	25 - BB	BB45	00:11
AL522	CTD	68	75	2019	5	2	27.05.19	04:27	04:32	147	543749	154505	59	59	25	BB	25 - BB	BB45	00:05
AL522	CTD	69	76	2019	5	2	27.05.19	05:47	05:52	147	545741	160007	51	51	25	BB	25 - BB	BB38	00:05

AL522	Bo/BABo 150, 335, 500	52	76	2019	5	2	27.05.19	05:54	06:02	147	544745	160002	51	51	25	BB	25 - BB	BB38	00:08
AL522	Bo/BABo 150, 335, 500	53	77	2019	5	2	27.05.19	07:17	07:24	147	544791	161551	50	50	25	BB	25 - BB	BB37	00:07
AL522	CTD	70	77	2019	5	2	27.05.19	07:28	07:33	147	545755	161512	49	49	25	BB	25 - BB	BB37	00:05
AL522	CTD	71	78	2019	5	2	27.05.19	08:26	08:31	147	545752	160012	74	74	25	BB	25 - BB	BB36	00:05
AL522	Bo/BABo 150, 335, 500	54	78	2019	5	2	27.05.19	08:34	08:43	147	545749	160002	74	74	25	BB	25 - BB	BB36	00:09
AL522	Bo/BABo 150, 335, 500	55	79	2019	5	2	27.05.19	09:46	09:57	147	550788	160099	87	87	25	BB	25 - BB	BB29	00:11
AL522	CTD	72	79	2019	5	2	27.05.19	10:00	10:06	147	550753	160021	87	87	25	BB	25 - BB	BB29	00:06
AL522	CTD	73	80	2019	5	2	27.05.19	10:56	11:01	147	550746	161402	80	80	25	BB	25 - BB	BB28	00:05
AL522	Bo/BABo 150, 335, 500	56	80	2019	5	2	27.05.19	11:08	11:18	147	550742	161486	80	80	25	BB	25 - BB	BB28	00:10
AL522	WS-Klein	12	80	2019	5	2	27.05.19	11:03	11:04	147	550745	161486	80	80	25	BB	25 - BB	BB28	00:01
AL522	Bo/BABo 150, 335, 500	57	81	2019	5	2	27.05.19	12:12	12:18	147	550782	163018	50	50	25	BB	25 - BB	BB27	00:06
AL522	CTD	74	81	2019	5	2	27.05.19	12:22	12:25	147	550755	163000	50	50	25	BB	25 - BB	BB27	00:03
AL522	CTD	75	82	2019	5	2	27.05.19	13:24	13:28	147	551747	163003	61	61	25	BB	25 - BB	BB26	00:04
AL522	Bo/BABo 150, 335, 500	58	82	2019	5	2	27.05.19	13:31	13:39	147	551746	163003	58	58	25	BB	25 - BB	BB26	00:08
AL522	Bo/BABo 150, 335, 500	59	83	2019	5	2	27.05.19	14:40	14:48	147	552780	163119	57	57	25	BB	25 - BB	BB13	00:08
AL522	CTD	76	83	2019	5	2	27.05.19	14:51	14:55	147	552757	163025	58	58	25	BB	25 - BB	BB13	00:04
AL522	CTD	77	84	2019	5	2	27.05.19	15:52	15:56	147	553749	163008	62	62	25	BB	25 - BB	BB12	00:04
AL522	Bo/BABo 150, 335, 500	60	84	2019	5	2	27.05.19	16:00	16:08	147	553744	163005	62	62	25	BB	25 - BB	BB12	00:08
AL522	Bo/BABo 150, 335, 500	61	85	2019	5	2	27.05.19	17:08	17:17	147	554779	163081	55	55	25	BB	25 - BB	BB11	00:09
AL522	CTD	78	85	2019	5	2	27.05.19	17:20	17:25	147	554752	163022	55	55	25	BB	25 - BB	BB11	00:05
AL522	CTD	79	86	2019	5	2	27.05.19	18:19	18:25	147	554752	161527	59	59	25	BB	25 - BB	BB09	00:06
AL522	Bo/BABo 150, 335, 500	62	86	2019	5	2	27.05.19	18:26	18:35	147	554745	161512	59	59	25	BB	25 - BB	BB09	00:09
AL522	Bo/BABo 150, 335, 500	63	87	2019	5	2	27.05.19	19:24	19:33	147	554791	160087	60	60	25	BB	25 - BB	BB08	00:09
AL522	WS-Klein	13	87	2019	5	2	27.05.19	19:35	19:38	147	554760	160031	61	61	25	BB	25 - BB	BB08	00:03
AL522	CTD	80	87	2019	5	2	27.05.19	19:44	19:48	147	555756	160031	61	61	25	BB	25 - BB	BB08	00:04
AL522	CTD	81	88	2019	5	2	27.05.19	21:03	21:08	147	553755	161493	74	74	25	BB	25 - BB	BB10	00:05

AL522	Bo/BABo 150, 335, 500	64	88	2019	5	2	27.05.19	21:11	21:21	147	553745	161484	75	75	25	BB	25 - BB	BB10	00:10
AL522	Bo/BABo 150, 335, 500	65	89	2019	5	2	27.05.19	22:07	22:17	147	553783	160096	74	74	25	BB	25 - BB	BB07	00:10
AL522	CTD	82	89	2019	5	2	27.05.19	22:20	22:25	147	553745	160029	75	75	25	BB	25 - BB	BB07	00:05
AL522	CTD	83	90	2019	5	2	27.05.19	23:15	23:20	147	553749	154510	69	69	25	BB	25 - BB	BB06	00:05
AL522	Bo/BABo 150, 335, 500	66	90	2019	5	2	27.05.19	23:23	23:31	147	553738	154510	69	69	25	BB	25 - BB	BB06	00:08
AL522	Bo/BABo 150, 335, 500	67	91	2019	5	2	28.05.19	00:21	00:29	148	553779	153022	67	67	25	BB	25 - BB	BB05	00:08
AL522	CTD	84	91	2019	5	2	28.05.19	00:33	00:38	148	553746	152995	67	67	25	BB	25 - BB	BB05	00:05
AL522	CTD	85	92	2019	5	2	28.05.19	01:28	01:33	148	553754	151503	72	72	25	BB	25 - BB	BB04	00:05
AL522	Bo/BABo 150, 335, 500	68	92	2019	5	2	28.05.19	01:35	01:45	148	553752	151500	72	72	25	BB	25 - BB	BB04	00:10
AL522	Bo/BABo 150, 335, 500	69	93	2019	5	2	28.05.19	02:35	02:45	148	553776	150011	75	75	25	BB	25 - BB	BB03	00:10
AL522	CTD	86	93	2019	5	2	28.05.19	02:49	02:55	148	553732	150009	75	75	25	BB	25 - BB	BB03	00:06
AL522	CTD	87	94	2019	5	2	28.05.19	03:44	03:48	148	553754	144499	67	67	25	BB	25 - BB	BB02	00:04
AL522	Bo/BABo 150, 335, 500	70	94	2019	5	2	28.05.19	03:51	03:59	148	553750	144496	67	67	25	BB	25 - BB	BB02	00:08
AL522	Bo/BABo 150, 335, 500	71	95	2019	5	2	28.05.19	07:06	07:14	148	551053	142415	44	44	24	AB	24 - AB	H12	00:08
AL522	CTD	88	95	2019	5	2	28.05.19	07:17	07:21	148	551048	142491	44	44	24	AB	24 - AB	H12	00:04
AL522	CTD	89	96	2019	5	2	28.05.19	08:36	08:38	148	545848	141604	42	42	24	AB	24 - AB	H15	00:02
AL522	Bo/BABo 150, 335, 500	72	96	2019	5	2	28.05.19	08:41	08:47	148	545837	141597	42	42	24	AB	24 - AB	H15	00:06
AL522	Bo/BABo 150, 335, 500	73	97	2019	5	2	28.05.19	09:44	09:49	148	545217	140244	42	42	24	AB	24 - AB	H16	00:05
AL522	CTD	90	97	2019	5	2	28.05.19	09:53	09:56	148	545196	140204	42	42	24	AB	24 - AB	H16	00:03
AL522	CTD	91	98	2019	5	2	28.05.19	10:55	10:57	148	544698	134694	42	42	24	AB	24 - AB	H19	00:02
AL522	Bo/BABo 150, 335, 500	74	98	2019	5	2	28.05.19	11:00	11:06	148	544699	134690	42	42	24	AB	24 - AB	H19	00:06
AL522	CTD	92	99	2019	5	2	28.05.19	12:30	12:33	148	544694	133007	43	43	24	AB	24 - AB	H20	00:03
AL522	WS-CTD	6	99	2019	5	2	28.05.19	12:51	13:01	148	544694	132997	43	43	24	AB	24 - AB	H20	00:10
AL522	Neuston	8	99	2019	5	2	28.05.19	12:05	12:15	148	544703	132985	43	43	24	AB	24 - AB	H20	00:10
AL522	Neuston	9	99	2019	5	2	28.05.19	12:20	12:30	148	544767	132903	43	43	24	AB	24 - AB	H20	00:10

7 Data and Sample Storage and Availability

All data obtained during the cruise have been backed up on a GEOMAR virtual drive that is backed up daily. In addition, data are stored on different hard drives in different locations. Paper protocols filled out during the cruise were entered electronically continuously throughout the cruise, and thus fall under the electronic back-up scheme, but have also been conserved as hard copies to resolve possible data entry errors later on if needed.

All cruise meta-data – including output of the on board DSHIP-System - have been entered in the GEOMAR Ocean Science Information System (OSIS), managed by the Kiel Data Management Team (KDMT), and intended for permanent archiving of such data. The data are freely available via the link https://portal.geomar.de/metadata/cruise/show/348649 (keyword “AL522”).

We aim to ultimately make all data accumulated during the cruise publicly available. All hydrographic (CTD) data will be submitted to the ICES database within one year from the cruise. Moreover, the KDMT team will assist with the publication of data in the public data repository PANGAEA to provide long-term archival and access. Some of the data are intended for specific publications, and will be published openly with the appearance of the underlying peer-review article. In these cases, please contact the person responsible for the data in case earlier access to the data is desired (Table 7.1).

All samples obtained during the cruise were labelled on board with a barcoding scheme, and all samples intended for longer-term storage were professionally archived immediately after the cruise. This includes formalin conserved samples for long-term storage, and frozen samples (-20°C and -80°C) currently conserved in freezer rooms at GEOMAR.

Table 7.1 Overview of data availability and persons responsible for specific data sets of AL522.

Type	Database	Available	Free Access	Contact
Hydrography (CTD data)	ICES database	Publicly by April 2020, earlier on request (see contact e-mail).	By April 2020	jdierking@geomar.de
Fishery data and food web sampling data	PANGAEA	Publicly at time of acceptance of the underlying peer-reviewed publication; or via request (see contact e-mail).		treusch@geomar.de
Ichthyoplankton data	PANGAEA	See above.		cclemmesen@geomar.de
Hydroacoustic data	PANGAEA	See above.		matthias.schaber@thuenen.de
Phytoplankton community sampling	PANGAEA	Inquire with collaboration partner (see contact e-mail).		luisa.listmann@uni-hamburg.de
microplastic sampling	PANGAEA	Inquire with collaboration partner (see contact e-mail).		treusch@geomar.de

8 Acknowledgements

I want to thank Captain Jan-Peter Lass and the entire crew of RV ALKOR for their outstanding support throughout the cruise and for the excellent and constructive working atmosphere on board. I also thank Svend Mees for his unwavering support, including in all technical matters, Christian Pawlitzki for his support both before and during the cruise, and the scientific personal and student assistants on AL522 for their enthusiasm and motivation. Special thanks also to the Polish observer Ms Katarzyna Spich for her help and support during our cruise.

9 Appendices

Electronic appendix E9.1 Station list of AL522. See at
https://portal.geomar.de/metadata/cruise/show/348649