Institute of Baltic Sea Fisheries (TI-OF)

THÜNEN

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Cruise Report

FRV „Walther Herwig III" Cruise WH415

27.03.2018-08.04.2018

Test and training cruise (fishery and survey technology)

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Co-scientist in charge: Dr. Daniel Stepputtis

In a nutshell

The main focus of this cruise was the test of the performance of several nets (fish and plankton), the test of new and modified technical equipment and the training on underwater vehicles.

During the cruise, several gears were deployed and observed using a remotely operated towed vehicle (ROTV):

- IMR-multisampler attached to a pelagic trawl (PSN205; with three codends)
- IMR-multisampler attached to a pelagic trawl (PSN205; with five codends)
- IMR-multisampler with preprogrammed time controled releaser and remotely controlled releaser via hydroacoustic modem, which was tested up to 1500m distance and 650m depths
- Isaacs-Kidd-Midwater Trawl (IKMT, Plankton Trawl)
- IKMT with multisampler midi (Plankton multisampler)
- Calcofi (Plankton trawl) with different setups
- Bongo (Plankton trawl)
- PSN205 (pelagic trawl): Measurement of net dimensions, mesh sizes, mesh angels and trawl forces to be used to validate net simulations

These tests were conducted in the region close to and inside Søgnefjord (Norway).

Additionally, some training with different technical setups for the ROV and the ROTV were performed and a link of the USBL-system to the ships navigation system was established and tested.

Narrative and results

FRV „Walter Herwig III" was equipped with fishing gears, plankton gears, a remotely operated towed vehicle (ROTV "JULI"), a remotely operated vehicle (ROV "Seaeye Falcon") and various other equipment (such as hydroacoustic modems and USBL positioning systems) on March 26th and 27th. In the morning of March 28th, the vessel left Bremerhaven to its first destination Helgoland. After one day of testing the equipment, the vessel continued to Norwegian waters at the evening of the 29th March. Different gears (multisampler, and plankton nets) were tested in Norwegian waters, close to or inside

Sogne-fjord. At 03/04/2018 13:00 UTC, the vessel left the investigation area and steamed back to Bremerhaven (arriving 05/04/2018 in the afternoon).

The overall cruise track can be seen in Figure 1.

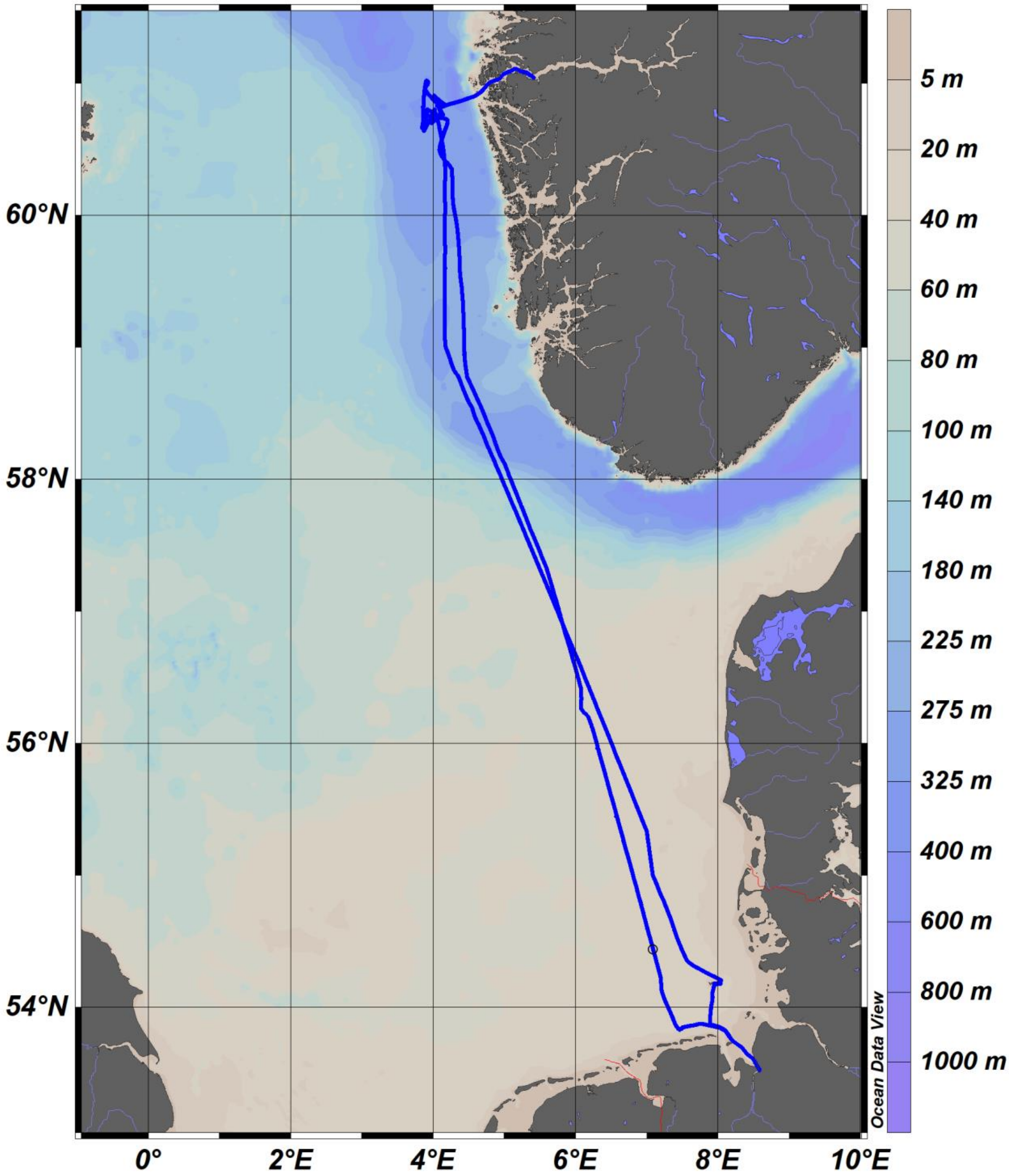

Figure 1: FRV „Walther Herwig III" Cruise WH415: cruise track, for station map, see Figure 14

1. Test of and training on ROV Seaeye Falcon

During 29th of March, the new setup of the ROV with its USBL underwater positioning system had been tested close to Helgoland. In this setup, the USBL-system was coupled to the ships gyrocompass and global positioning data system. Further, a new mounting bracket for the shipside USBL modem was installed and successfully tested (see Figure 2).

The ship anchored during the training (bow-anchor). The maneuvering of the ROV was very challenging under conditions of high tidal currents. With the change of tide, the current decreased and the maneuverability of the ROV improved, especially when using the ship-coupled USBL system.

Some technical problems (optical fibre optic connection and leakage of the connection unit) have been detected and were fixed afterwards.

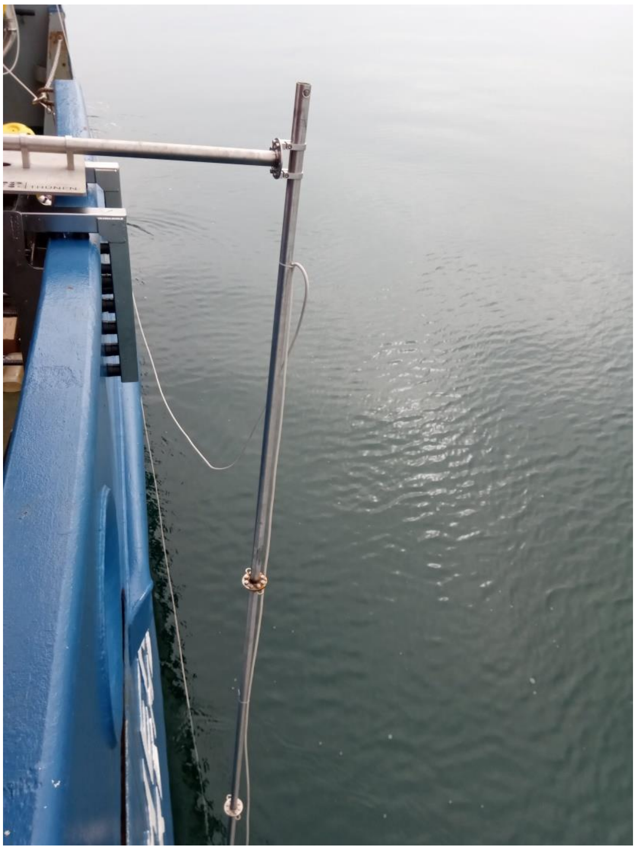

Figure 2: Mounting bracket for the shipside USBL modem

2. Test of and training on Mini ROV BlueROV2

At the same station (close to Helgoland), the Mini ROV BlueROV2 (www.bluerobotics.com) was tested. Due to the use of autopilot hard- and software, which is originally used in multicopters, this ROV has shown very convincing stabilization algorithms and maneuverability, including under high current conditions.

3. Test of and training on ROTV JULI

The ROTV "JULI" was tested on the way from Helgoland to Norwegian waters. Additionally, some training was performed.

Some technical problems (optical fibre connection) have been detected and were fixed before deployment in Norwegian waters.

4. Test of IMR-multisampler setups with pelagic trawl PSN 205

The IMR-multisampler (Figure 3) is typically used during several surveys, including the hydroacoustic surveys in the Irminger Sea and the Eel-Survey to Sargasso-Sea.

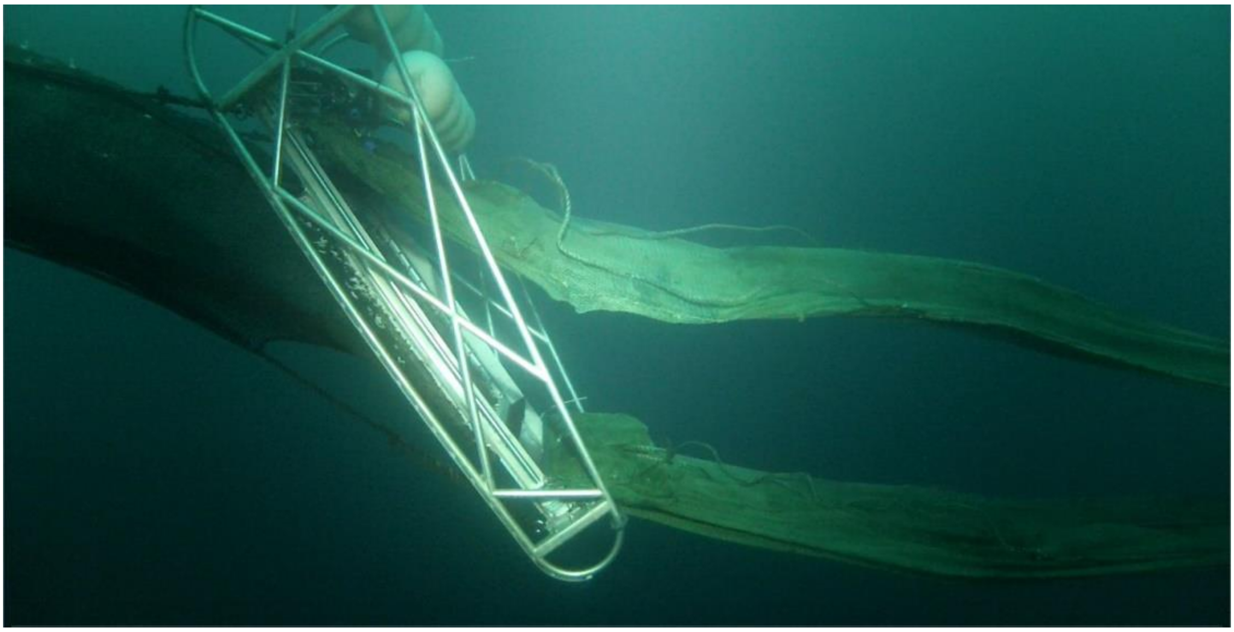

Figure 3: Screenshot from underwater recordings (ROTV-view) of the multisampler attached to the PSN205

To ensure a proper functionality, the multisampler was tested during this cruise. The ROTV "JULI", equipped with different cameras, was used to "fly" around the gear. Prior to the cruise, one battery pack and the defect mounting clamps had been repaired and a hydroacoustic modem was installed to give the alternative possibility to control the multisampler remotely. The IMR-multisampler was attached to the pelagic trawl PSN 205 in order to

a) evaluate problems reported on earlier cruises (sporadic malfunction)
b) test of a remote control for the multisampler
c) test of an increased number of codends attached to the multisampler (5 codends instead of 3 codends)

All three topics were addressed successfully during the cruise. Details are given below

a) evaluate problems reported on earlier cruises (sporadic malfunction)

Earlier cruises reported sporadic malfunction of the closing mechanism. Therefore, the battery packs (Akkus) of both systems were checked prior to the cruise and replaced in one system. Nevertheless, the sporadic malfunction was also found during the first hauls of the current cruise. Afterwards, the problem was identified as malfunction of one SUBCONN-connector in one of the motor units. This connector will be repaired after the cruise. All other components worked properly.

b) test of a remote control for the IMR-multisampler

In the standard configuration, the closing mechanism of the IMR-multisampler has to be pre-programmed to open and close the different codends at given time intervals. This might work in many cases. Nevertheless, this procedure limits the flexibility to react to (e.g.) delay in fishing operation and unexpected stratification of fish distribution. Therefore, the aim was to supplement the preprogrammed operation mode with the possibility to control the opening and closing of the codends remotely.

An Evologic-underwater acoustic modem was used to establish a remote connection to the control unit of the IMR-multisampler. The acoustic modem consists of a hydrophone, towed close to the surface (see description of deployment setup below) and an underwater hydrophone, connected to the control unit of the multisampler (Figure 5). To transfer and receive signals from the underwater unit, commands were sent using a specific computer program.

c) test of multisampler attached with five codends
In the standard setup, three codend are attached to the multisampler, where the multisampler can have seven states: At the beginning, all codends are closed. Then sequentially each codend can be opened and closed again. To be able to sample more strata during one haul, the multisampler was modified to control five codends. This setup also starts with all codends closed. After the first codend is openend the closing of the following codend will simulateously open the next codend until the last codend is closed.

The investigations were conducted in the Norwegian Trench, west of Norway at April 1st in shallow depth for camera observations and in the Søgnefjord in depths of 650m at April 2nd to test the range of the remote control functions.
The software and hardware setup had been improved to achieve a stable setup for both options. In addition to software improvements, the setup for the deployment of the towed hydrophone (shipside modem) had been modified to improve the communication range and stability of data communication between the topside unit and the multisampler. Finally, the hydrophone was towed using the starboard crane and a depressor (Figure 4).

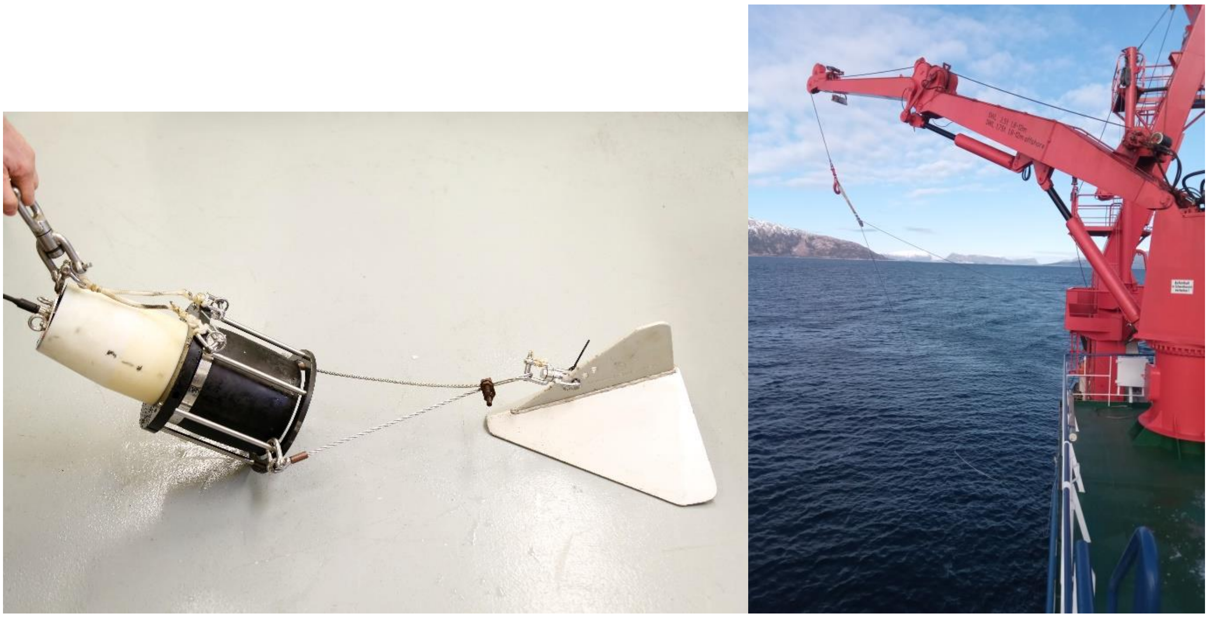
Figure 4: Shipside modem for remote link to the multisampler and setup for successful communication

The remote control of the multisampler was tested **up to a depth of 650m** without any problems. Finally all setups worked as expected. Sufficient underwater-recordings were obtained. Nevertheless, to ensure maximum reliability, the controller of the IMR-multisampler was programmed in a way that it runs its preprogrammed time schedule in case of communication problems of the remote-control-system. Therefore, the remote control-device is an option to ensure maximum flexibility, but it can also be used like during previous cruises as preprogrammed multisampler without any further hardware adaptation.

The documentation that describes the use of the remote control software had been updated.

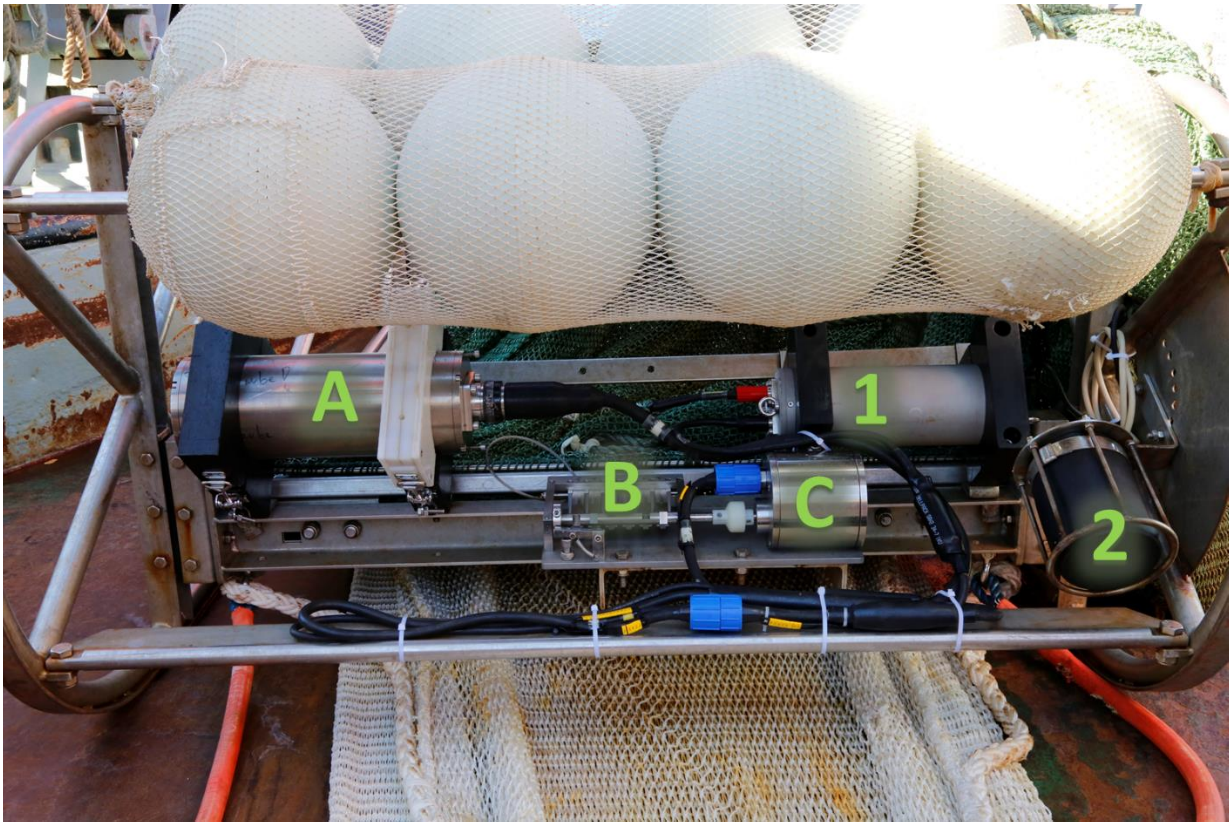

Figure 5: IMR-multisampler with Evologic-USBL-modem for remote control (close-up view) with labelled devices

In Figure 5 the original components of the IMR-multisampler are labelled with letters:

A) controller unit with battery,
B) releaser unit,
C) motor-unit for releaser

and the new components are labelled with numbers:

1) Evologics underwater modem with battery,
2) Evologics hydrophone (orientation adjusted to point towards vessel during towing).

5. Test of IKMT-plankton net

The Isaacs-Kidd-Midwater Trawl (IKMT, Plankton Trawl) is the ichthyoplankton sampling device used for the Sargasso Sea-Eel-Survey (WH342 in 2011, WH373 in 2014 and WH404 in 2017).

The aim of the current cruise was to test the IKMT in combination with the Hydrobios-multisampler (midi). The IKMT is used for ichtyoplankton-Surveys because it offers a large net opening. On the other hand, the standard-configuration of the IKMT does not allow the discrete sampling of different depth strata. Since this stratified sampling is required to obtain important insights in the biology of different ichthyoplankton species, we investigated the possibility to add multisampling-capabilities to the IKMT.
Some requirements were

- reliable multisampler-mechanism,
- relative small size for deployment on FRV “Walther Herwig III”,
- cost efficient.

Therefore, we have decided to use the available (hence cost efficient) Hydrobios-multisampler (size midi, 0.25m²) instead of the standard-IKMT-codend (Figure 6). To level out part of the weight of the Hydrobios-multisampler, floation devices were attached to the multisampler (figure 6). During the first hauls, the multisampler was attached to the aftend of the IKMT, as well as to the front part of the IKMT (horizontal bar and depressor) using long strain reliefs. The use of long strain reliefs was found to be not optimal due to several reasons. The main reason is that it is rather difficult to adjust the length of the strain reliefs. Therefore, the strain-reliefs were shortened and attached to the last meshes of the outer net of the IKMT (Figure 6) for subsequent deployments.

Figure 6: Hydrobios-Multisampler (size midi, 0,25m²), attached to the aftend of the IKMT

The underwater observation using the ROTV "JULI" revealed fundamental problems in the IKMT-multisampler setup (Figure 7). The weight of the multisampler was too high – even with buoyancy-floats - to "fly" behind the IKMT and to ensure a sufficient water flow through the IKMT into the multisampler codends. As consequence, **the buoyancy** of the multisampler **needs to be increased** prior to further tests.

Figure 7: Screenshot from underwater recordings (ROTV-view) of the multisampler, attached to the IKMT

6. Test of CalCOFI-plankton trawl (different setups)

The CalCOFI-plankton trawl (CalCOFI = California Cooperative Oceanic Fisheries Investigations) is widely used for quantative investigation of zoo- and ichthyoplankton (e.g. to sample larger herring larvae in the Baltic Sea). The CalCOFI-trawl consists of a 100 cm diameter stainless steel ring, equipped with a 4 meter long net bag. Additionally, a 22 kg V-Fin depressor is attached to the lower side of the gear to obtain stability and downward-forces.The aim of the recent test was to evaluate different rigging-options of the plankton-trawl by underwater observation using ROTV "JULI". The reasons for this test were reports from previous deployments that the fishing performance of the standard configuration was not optimal.

Table 1: CalCOFI-configurations tested during WH415

<table>
<tr><td></td><td>configuration 1 (standard)</td><td>configuration 2</td><td>configuration 3</td></tr>
<tr><td>figure</td><td>Figure 8, Figure 9</td><td></td><td>Figure 10</td></tr>
<tr><td>mesh size</td><td colspan="3">1550µm</td></tr>
<tr><td>depressor</td><td colspan="3">22kg V-fin</td></tr>
<tr><td>depressor attachment</td><td>at lever arm</td><td colspan="2">directly at lowest part of the steel ring</td></tr>
<tr><td>bridles</td><td>equal length
3x105cm</td><td>unequal length
top: 2x 70cm
bottom: 1x 120cm</td><td>unequal length
top: 2x 100cm
bottom: 1x 120cm</td></tr>
</table>

Unfortunately, it was not possible to measure the tilt of the steel ring (net opening) to vertical. Instead, the tilt was roughly assessed using underwater observation with ROTV "JULI". Based on these observations, configuration 1 resulted in a slight forward tilted tow position, whereas configuration 2 resulted in a slight backward tilted position.

The direct attachment of the depressor to the steel ring had no obvious negative effect to the tow performance, but made the construction simpler and should be used in future deployments.

Figure 8: CalCOFI-plankton-trawl in configuration 1 (see Table 1) during deployment (note, the attachment of the depressor to a lever arm and equal length of bridles)

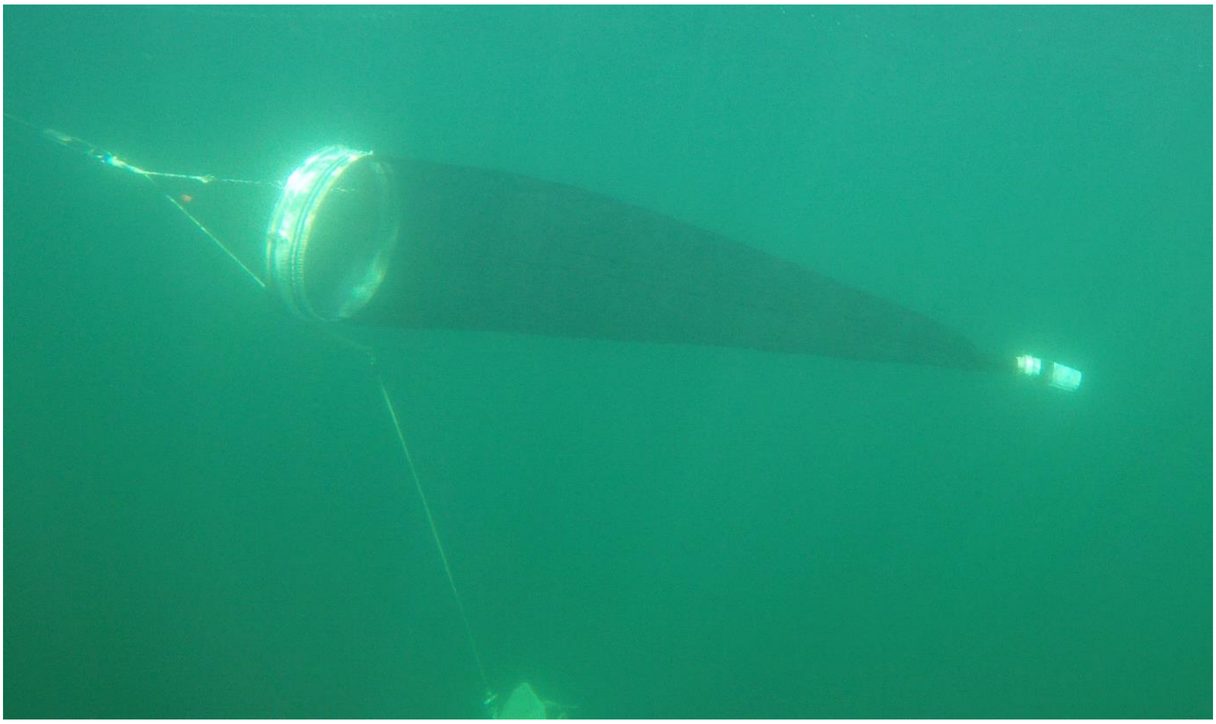

Figure 9: CalCOFI-plankton-trawl (ROTV-view) in configuration 1 (see Table 1)

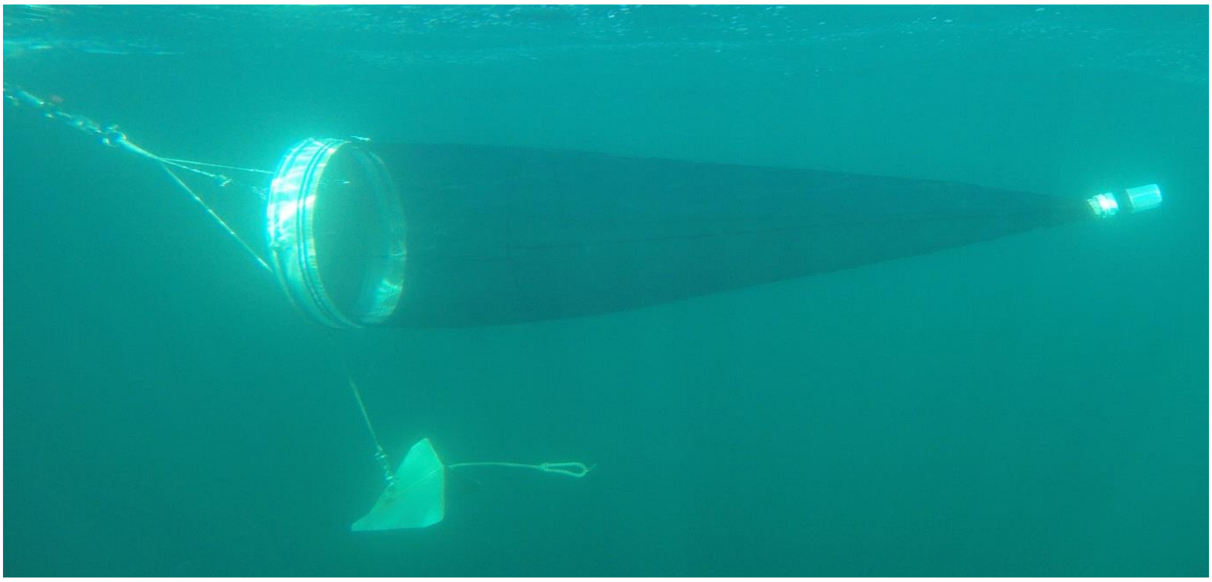

Figure 10: CalCOFI-plankton-trawl (ROTV-view) in configuration 3 (see Table 1)

7. Test of other plankton-trawls

To obtain underwater video-footage of the Bongo-plankton trawl and the Hydrobios Multisampler (midi, size 0.25m²), these devices were deployed and observed using ROTV "JULI".

The multisampler was used in tow configuration (5 nets, 500µm mesh opening, soft codends, 22kg V-fin-depressor, top bridles in first hole, lower bridles in third hole).

8. Measuring dimensions and forces for net simulations on PSN205

Colleagues from the University of Rostock develop a tool to simulate the performance of underwater structures - such as trawls. For the evaluation of such tool, observations and data of the performance of trawls are required.

Therefore, we measured and recorded different parameters for the PSN205 during towing

- shape of meshes in 5m distances along the trawl (Figure 11)
- shape of the net (different cross sections in 5m distances along the trawl; starting from the sweep lines towards the codend) (Figure 12)
- tension force at the wings of the trawl using NKE-tension-shakles (position see Figure 13)

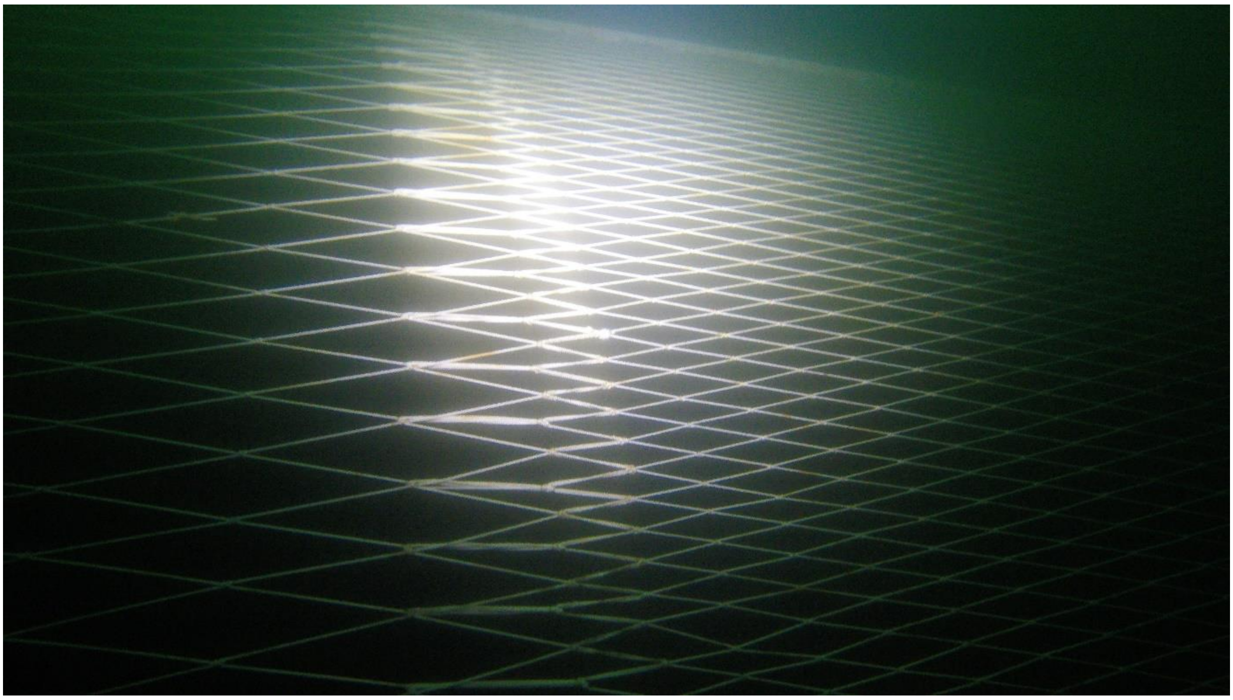

Figure 11: example screenshot (view from ROTV „JULI”) of PSN205 netting during towing shows the shape of meshes

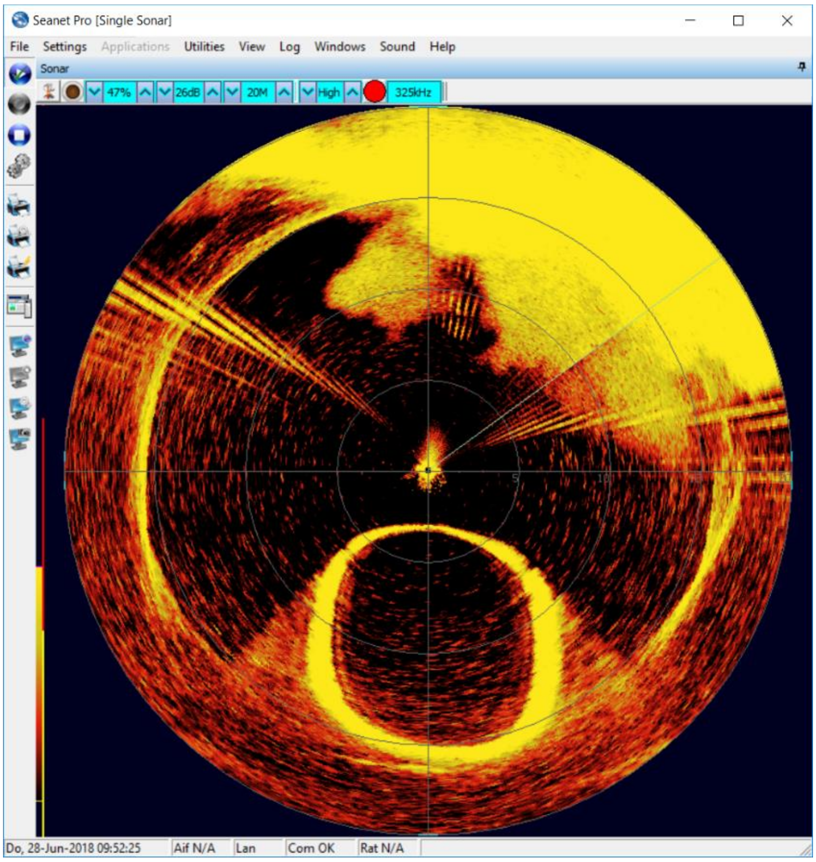

Figure 12:example screenshot (scanning sonar at ROTV „JULI“) of PSN205 netting during towing shows the shape of net

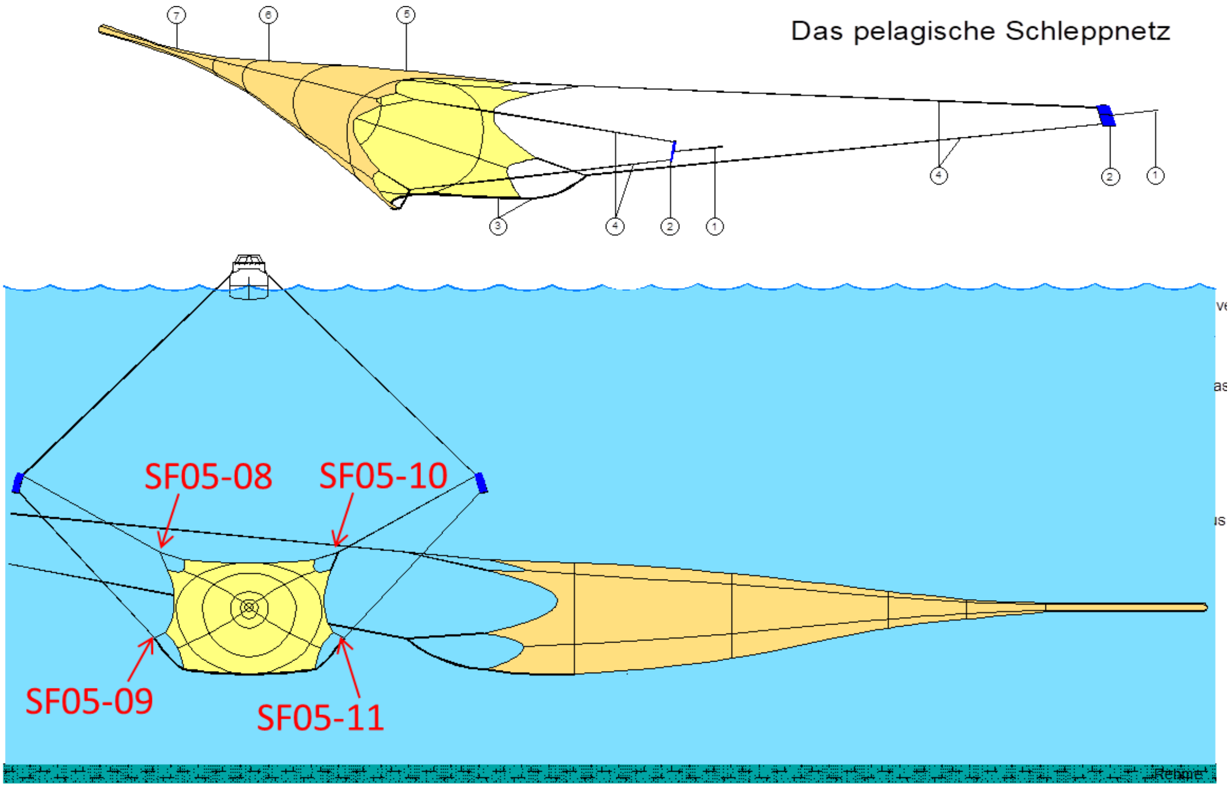

Figure 13: schematic view of pelagic trawl and positions of tension-sensors (given are IDs for each sensor and position)

9. List of stations

Table 2: FRV „Walter Herwig III“ Cruise WH415: station list

Station ID	Gear/ Device	Date (start)	Time (start)	Date (end)	Time (end)	Latitude	Longitude
291	ROV	29.03.2018	07:05:44	29.03.2018	09:24:00	54°12,276N	008°02,898E
292	ROTV	29.03.2018	13:55:55	29.03.2018	14:45:35	54°19,324N	007°38,429E
293	ROTV	31.03.2018	06:16:36	31.03.2018	08:59:21	60°46,674N	004°00,219E
294	Pelagic trawl / multisampler	31.03.2018	09:59:18	31.03.2018	11:19:36	60°39,699N	003°50,783E
295	CTD	31.03.2018	13:40:02	31.03.2018	14:10:25	60°44,769N	003°54,287E
296	Pelagic trawl / multisampler	01.04.2018	06:17:34	01.04.2018	08:27:47	60°47,161N	003°54,878E
297	IKMT / multisampler/ ROTV	01.04.2018	12:06:14	01.04.2018	12:48:59	60°56,899N	003°53,343E
298	IKMT / multisampler/ ROTV	01.04.2018	14:10:02	01.04.2018	15:03:08	60°52,850N	003°59,563E
299	Pelagic trawl / multisampler	02.04.2018	07:00:10	02.04.2018	08:44:14	61°05,359N	005°13,550E
300	IKMT/ ROTV	02.04.2018	12:07:37	02.04.2018	12:35:56	60°50,041N	004°10,149E
301	Calcofi/ ROTV	02.04.2018	12:46:14	02.04.2018	12:56:51	60°50,931N	004°08,245E
302	Calcofi/ ROTV	02.04.2018	13:32:19	02.04.2018	13:45:45	60°51,486N	004°06,816E
303	Calcofi/ ROTV	02.04.2018	13:51:57	02.04.2018	13:57:14	60°52,035N	004°05,611E
304	Bongonetz/ ROTV	02.04.2018	14:06:42	02.04.2018	14:13:46	60°52,463N	004°04,674E
305	Multisampler/ ROTV	02.04.2018	14:37:50	02.04.2018	15:00:27	60°53,325N	004°02,734E
306	Pelagic trawl/ multisampler/ force shackles/ ROTV	03.04.2018	07:51:27	03.04.2018	10:47:50	60°33,304N	004°06,829E
307	CTD	03.04.2018	11:03:58	03.04.2018	11:23:20	60°23,734N	004°11,558E
308	Pelagic trawl / multisampler	03.04.2018	11:32:23	03.04.2018	12:24:52	60°23,626N	004°12,246E

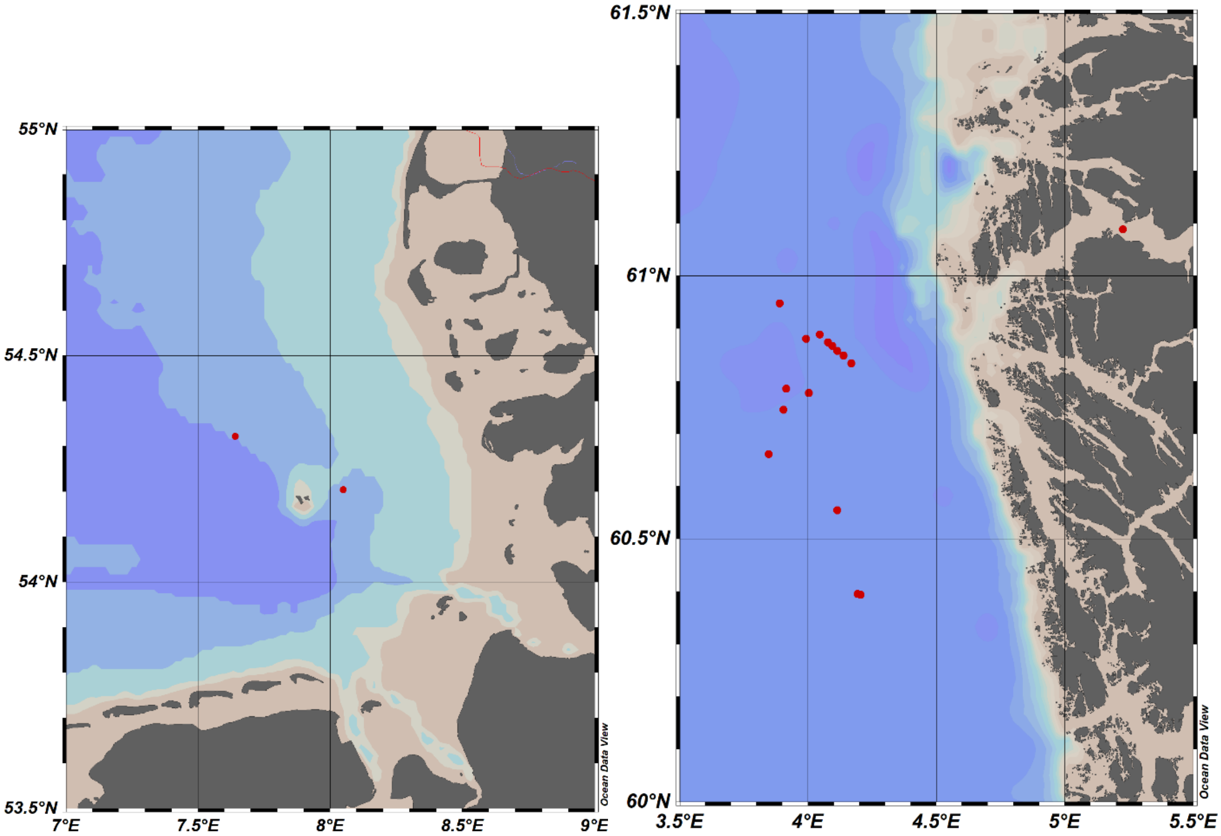

Figure 14: FRV „Walter Herwig III“ Cruise WH415: positions of stations

10. Personnel

Dr. Andreas Hermann	Scientist in charge	TI-OF
Dr. Daniel Stepputtis	Co-Scientist in charge	TI-OF
Ulf Böttcher	Electronic Engineer	TI-OF
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André Reuter	Scientist	HydroBios

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