Cruise report

M/T Paamiut
Hellefisk Survey Togt 7 (Leg 7, Greenland halibut stock assessment survey)
Benthic imaging survey
10th Oct – 24th October 2017
Greenland, Nuuk to Nuuk

Personnel

Benthic Imaging: Chris Yesson[1], Stephen Long[1,2], Mona M. Fuhrmann[1]
Cruise leader: Ole Jørgensen[3]

[1]Institute of Zoology (IoZ), Zoological Society of London (ZSL)
[2]University College London (UCL)
[3]National Institute of Aquatic Resources, Technical University of Denmark (DTU Aqua)

Objectives

The cruise was conducted in the southern area of the west Greenland offshore Greenland halibut fishery and adjacent areas, all within NAFO areas 1A and 1B. This report describes the benthic ecosystem research that was conducted alongside the annual Greenland halibut stock assessment survey. Specific objectives were to:

1. Conduct video surveys of seabed to map benthic communities and their habitat, in particular vulnerable marine ecosystems (VMEs) indicator species
2. Collection of video across a spectrum of fishing effort to analyse the impact of trawling.
3. Testing of scaling lasers added to the video sled rig.
4. Collection of benthic bycatch data from stock assessment trawls using Alfredo trawl.
5. Collection of benthic community abundance and biomass data using a beam trawl.

Summary of work

The survey was a joint venture between the Greenland Institute of Natural Resources (GINR) and the Institute of Zoology (IoZ). Our agreement with GINR was to conduct video and beam trawl surveys using 48 hours of ship time. Due to adverse weather conditions we were able to use 39 hours of ship time on this cruise. Sampling time was shared between the video survey (23 stations) and beam trawls (8 stations), with a focus on collection of seabed video footage at stations along a trawling effort gradient (fig. 1, Appendix I). Trawling effort was determined using digitised, anonymised fishing vessel logbook data (2012 to 2016, inclusive) provided by Rasmus Nygaard of GINR. A sub-sample of stations were selected from the Greenland halibut stock assessment survey stations. Typically these were conducted after trawls, taking care not to sample the exact location to avoid a disturbance bias. The use of the video sled was successful, seafloor videos were obtained from stations between 63˚11.01' N and 65˚15.92' N, at depths ranging from 650 to 1476 m. This was the first time we have used this equipment at depths exceeding 1000m. Bottom substrates sampled were dominated by mud with occasional dropstones (isolated rocks). Aside from the adverse weather conditions, our major challenges were optimising the drag speed and wire length during towed video deployment in variable conditions to ensure clear consistent video was acquired. Beam trawls were taken at depths ranging from 720 to 1431m with the main purpose of complementing video stations and aiding identification. A camera was mounted to the beam trawl to obtain additional video, which resulted in short sequences providing additional information on sampling efficiency of the beam. GINR documented all benthic fauna taken as bycatch from Alfredo trawls as a reference collection and to support subsequent research.

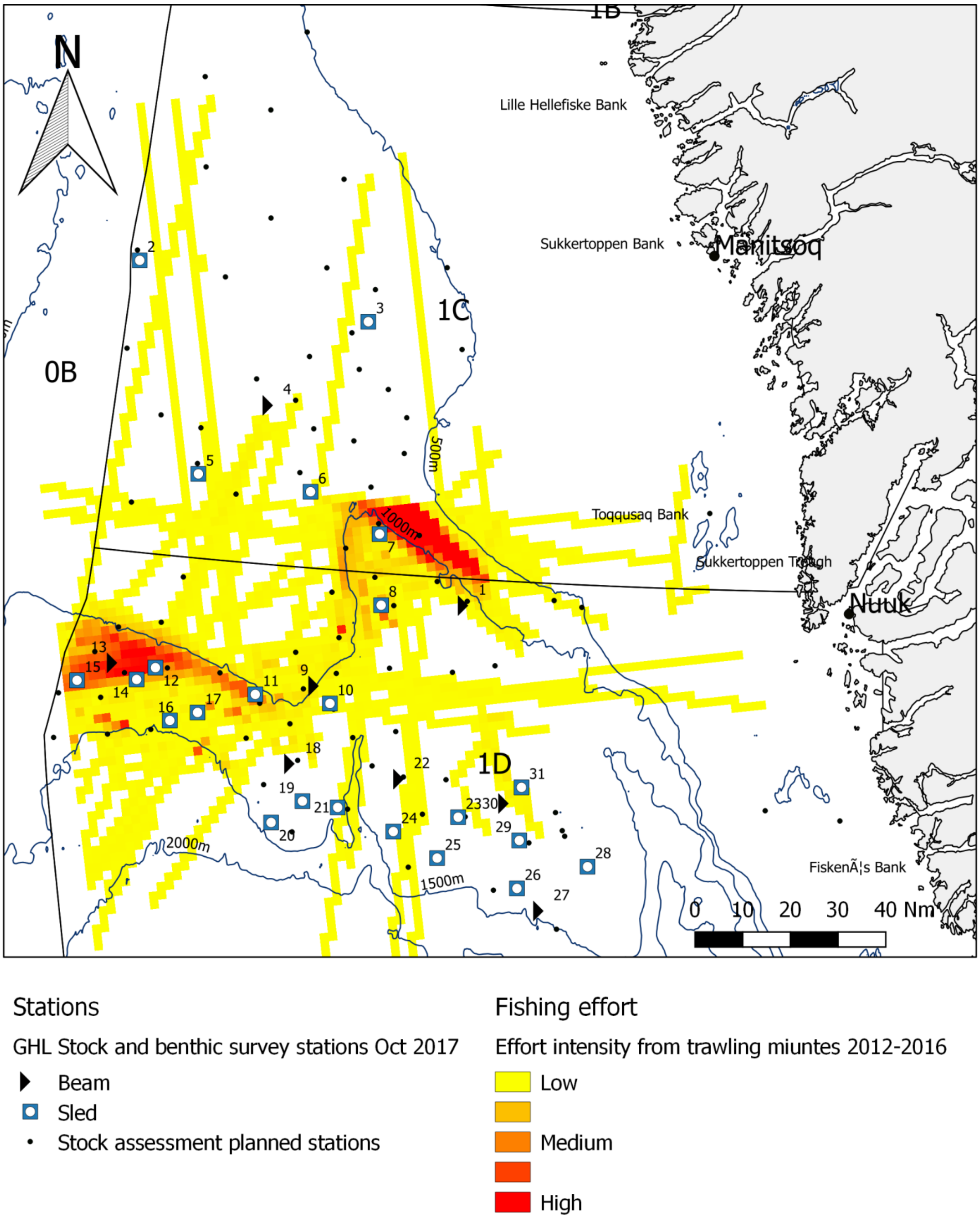

Figure 1: Map showing beam and video sled survey stations sub-sampled from the planned Greenland halibut stock assessment survey stations. Many of the northern stations were omitted from the stock assessment survey (and thus the benthic video survey) due to adverse weather at the start of the cruise. Preliminary representation of combined effort data from logbooks 2012-2016 inclusive, where total minutes between start and end of trawls are allocated to 3.5 km grid. Straight lines extending beyond the main footprint are thought to represent positional errors to be excluded in future analyses. Contours are drawn at 500m intervals. NAFO areas are indicated. Survey designed to sample the southern area of the west Greenland offshore Greenland

Halibut fishery and adjacent areas between 800 and 1500m in the Davis Strait, west Greenland.

Equipment and sampling

Adverse weather

The cruise was severely disrupted by adverse weather conditions. For the first 3 days (10th-12th October) and the final three days of the cruise (21st-23rd October) there were gale force winds (measured up to 26m/s) and high waves severely disrupting sampling. It was felt that these conditions were too dangerous for gear deployment. One beam trawl was attempted on October 11th, as this was felt to be a safer deployment in rough conditions. The first video sled deployment was on 13th October, at which point uninterrupted surveys began. The forecast for the final three days was so bad it was decided that no sampling could be attempted and the ship returned to port, curtailing the cruise.
The sampling began in the northern region of the survey and moved steadily southwards. The uncertainty caused by the extreme weather resulted in no sampling at many of the northernmost stations. In good conditions, the sampling proceeded apace, resulting in a higher density of stations in the southern region of the survey. It was hoped that some of the norther stations could be revisited at the end of the survey, but the reappearance of poor conditions meant this was not possible.

Sampling time

The cruise plan was for 48 hours of video sled/ beam trawl sampling time, to be taken throughout the cruise at a subset of the stock assessment stations. On agreement with the cruise leader, Ole Jørgensen, our sampling time was measured from the start of gear change (moving Alfredo nets) covered the gear setup, deployment, towing and gear retrieval and stopped when our video sled/beam trawl gear returned to the deck and we could begin transit to the next station. Our initial estimate was that this process would take on average 90 minutes (dependent on depth of deployment). As the crew became accustomed to the gear change procedure, the gear setup time reduced. On average, the deployment of the video sled at depths of around 1000 m took an hour and 15 minutes, breaking down to 30mins setup, 15 mins descent, 15 mins tow time and 15 mins retrieval. The ascent/descent of the video sled was approximately 60m per minute.
Of the 48 hours originally assigned to benthic sampling, only 39 hours were used, meaning that 9 hours of sampling time were unused on this cruise.

Benthic sled with GoPro camera

High definition video footage was obtained using GINR's benthic video sled system (fig 2). This is a towed forward-facing GoPro video camera in a deep water housing, coupled with Nautilux torches in GB-PT 1750 group binc underwater housings (see cruise report June 2017 for full specifications). Temperature was monitored by a Starmon sensor. Each video sled trawl was deployed for 15 min of bottom-contact time. Trawl data (depth, time, location etc) was recorded and entered into the common database (MS Access) designed and maintained by GINR. These were entered as part of the station sequence for the cruise and identified by the gear type 'video sled'.

The camera and lighting angles on the sled were set according to previous trials, from which permanent marks had been made on the sled. To prevent slippage issues these were spot welded to ensure consistency. In the past difficulties were experienced with the torch wires becoming detached during the process of screwing/unscrewing for setup. This was resolved by reconfiguring the arrangement of battery and circuit by adding an additional power cable to allow access without disturbing the circuit boards. Additional challenges were experiences with lights turning off when the sled made heavy contact with the ship or seafloor. This was resolved by soldering fragile wire connections and immobilizing circuitry using a rigid plastic sleeve and cable ties.

Initial use of the video sled used specifications based on trials in shallower areas (50-800m) during the cruise of June 2017. However, optimum towing speed for deployment at 1000m depths was adjusted to 1-1.2 knots, and the ratio of the wire length to depth was reduced to 1.2 (e.g. for 1000m stations 1200m of wire was deployed). As previously, net floats were added to the towing chain immediately in front of the sled. These modifications reduced the chance of slack wire stirring up sediment ahead of the camera. It is also preferable to tow against the seabed current (where this was known/guessed). It is noted that the sled tended hop along the seabed, or move in a stop/start motion, rather than the continuous motion observed in the original pilot. This may have been caused by wave action or the sled getting “stuck” in the sediment. Additional floats were attached to the sled to reduce friction with the seabed, but this had limited affect in remedying the issue.

There was an additional issue with the amount of winch wire let out during deployment. The counter on the wire spool experienced some slippage, resulting in uncertainty over the true wire length being deployed, typically resulting in too much wire being deployed. This resulted in excess wire touching the ground in front of the sled and stirring up a sediment cloud, obscuring the video. We recommend using the 1.2 wire length to depth ratio for deployments at similar or greater depths. Depending on the accuracy of the wire counter it may be appropriate to adjust this in future.

Scaling lasers

In order to improve video image interpretation and scaling a pair of 5mW Z-bolt green lasers were integrated into the video sled system. A custom underwater housing was designed and made by Stephen Long at University College London’s (UCL) Institute of Making, with assistance from the Department of Mechanical Engineering. The housings remained water tight at depths of ~1400m. Unfortunately the lasers were prone to weakening and turning off. This was thought to be due to the temperature and physical stresses. Nevertheless, it was possible to acquire video with two dots a known distance apart (20cm). This represented a significant cost saving as equivalent commercially available products are prohibitively expensive. This will aid subsequent analysis. In future a more rugged laser could be sought or the existing product could be customized to improve durability. The lasers were mounted directly beneath the camera (fig 2), to provide central positioning of the lasers on the image. However, the prominent position of the lasers meant they were repeatedly struck either on deck or during deployment, this infrequently led to difficulties removing the camera as the casing for the laser housings warped on impact. It is recommended that the lasers are repositioned to avoid this issue.

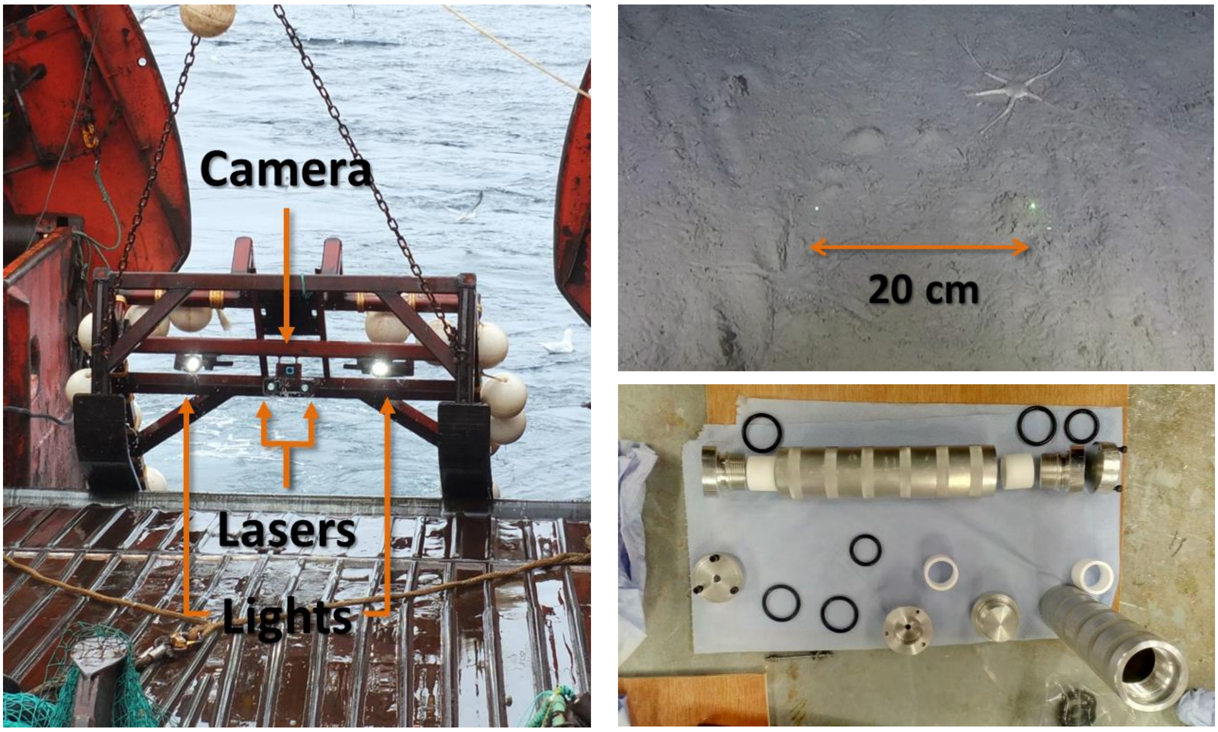

Figure 2: Clockwise from left, camera sled showing camera lights and laser postions, example still from video showing laser dots 20cm apart, purpose built laser housing.

Beam trawls and bycatch processing

A GoPro camera and two Nautilux torches in GPH-1750 Group Binc underwater houses were mounted on the beam trawl. Initial deployment of the beam trawl was for 10 minutes of bottom contact at 1kt, in order to maximise video footage. However, the sea conditions meant consistent deployment at 1kt was difficult and the first deployment collected a large amount of benthic fauna. Subsequent deployments were reverted to the ‘typical’ setup of 5 minutes tows at speeds exceeding 1 knot. Frequently, the disturbance of soft sediments obscured the view in the beam trawl videos, this meant that the quality of beam trawl video was not as good as the video sled and is unlikely to be suitable for quantitative analysis. However, typically the first minute of footage produced clear video, which may be useful for other purposes. Often the catch brought up a lot of muddy sediment, and it helped to rinse the net out in the water before bringing it on board (given that no large stones were in the catch, in which case this technique would additionally crush specimens). Catches were processed according to previous protocols designed by Martin Blicher (GINR) for the INAMon project. Specimens were identified and documented by Igor Manushin, Jan Yde Poulsen and IoZ participants. Some specimens were kept and dried for outreach purposes.

There were some technical issues with the Starmon sensor on the beamtrawl; it seems to have registered unrealistic temperatures that were out of step with other readings, which were therefore not entered into the database. GINR documented abundance and biomass of all benthic fauna taken as bycatch from Alfredo trawls. Data was entered in the cruise database, described above.

Results

Video

Because of bad weather the more easterly high effort fishing area could was undersampled, it is hoped this can be addressed on a cruise in 2018. Beds of *Halipteris finmarchica* were found in the northern area and these were also caught in Alfredo trawls (see below). A few species were only observed on videos and not sampled by beam trawl, for example *Radicipes cf. gracilis*, and an unidentified anemone (Fig.3).

Figure 3: Left, *Radicipes cf. gracilis* (St 13, 822 m). Right, Unidentified sea anemone at St 80, 1129 m. Bottom, Unidentified sea anemone at St 35, 1102 m.

The cup coral *Flabellum alabastrum* was common at deeper stations, often at high abundances in assemblage together with the brittle star *Ophiomusiom lymani* (Fig.4). Cup corals were easily displaced by the video sled, but probably slipped through meshes of the Alfredo trawl since they were seldom caught as bycatch. They were also seen in higher fishing effort stations, but in lower abundance. The sea urchin *Phormosoma placenta* was encountered across the fishing effort spectrum.

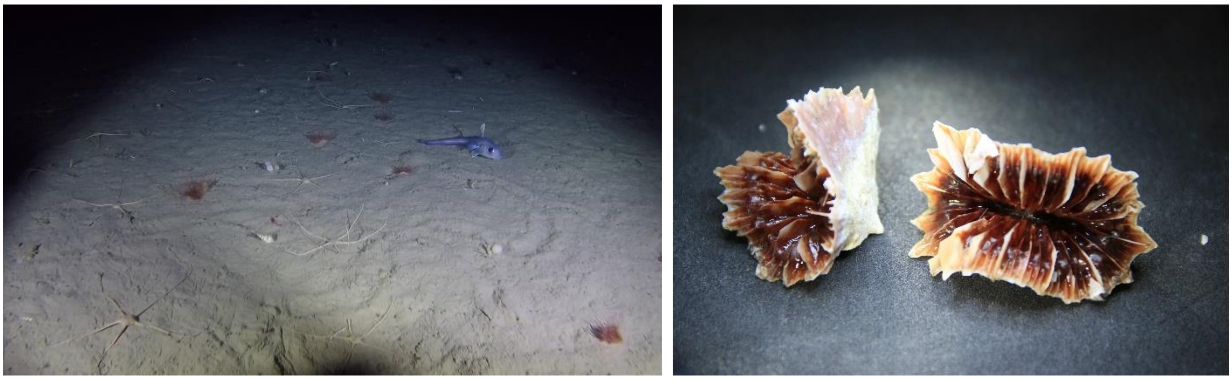

Figure 4: Left, High abundance of *Flabellum alabastrum* and *Ophiomusium lymani*. Right: *Flabellum alabastrum s*pecimens from beam trawls.

Whilst soft sediments were dominant, coral and sponges were often observed, associated with the hard substrate offered by rocks/dropstones (fig. 5).

Figure 5: Stones offer attachment to a variety of species, i.e black corals (Stauropathes spp) and an unidentified sponge at 1336 m.

Preliminary impressions of the footage showed a stark contrast between trawled and untrawled areas. Trawled areas were typically flatter seabed with less diverse fauna and fewer dropstones. Observable trawl marks were widespread, in addition to furrows caused by trawl doors, features consisting of a series of linear grooves were observed in areas subject to fishing effort. This rake like pattern of grooves (fig. 6) may be caused by rock-hopper gear, chains or roller 'clumps' position between pairs of nets.

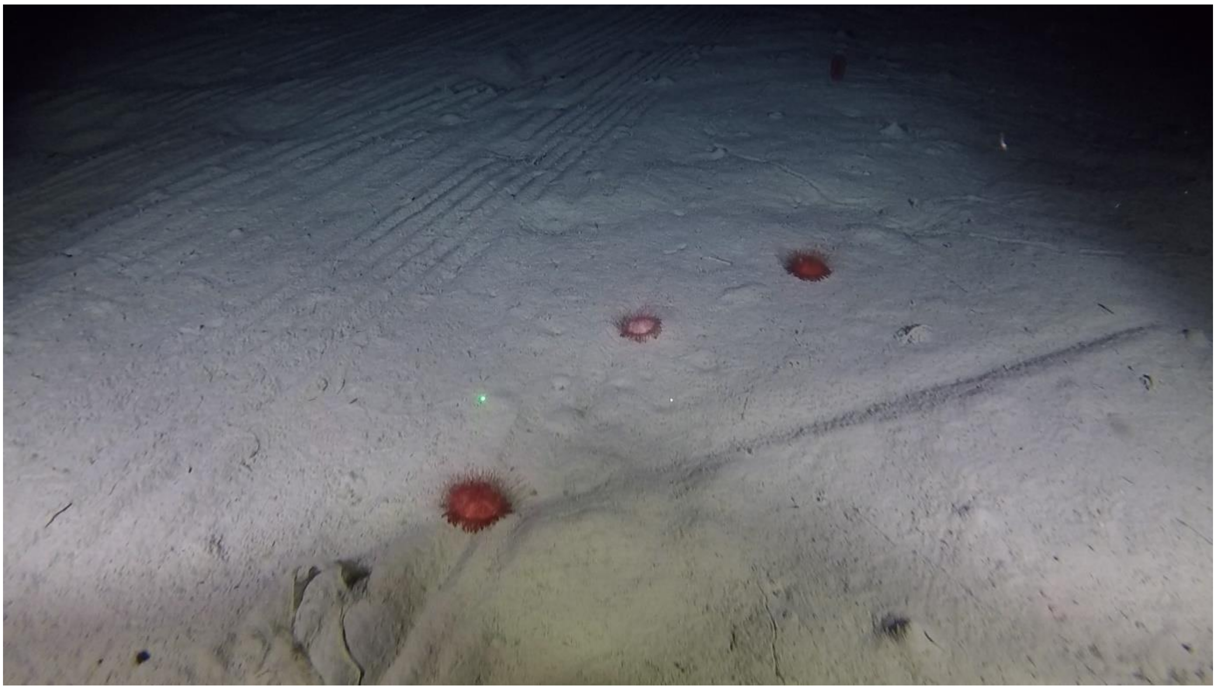

Figure 6: Trawl marks were frequently seen on the seafloor in areas of high fishing effort. Here at St 58 at a depth of 1250 m, next to the abundant sea urchin *Phormosoma placenta.*

Fish were frequently seen in videos, i.e. Grenadier fish (family: Macrouridae). However, Greenland halibut (*Reinhardtius hippoglossoides*) were rarely observed since they likely escaped the video sled which ran at low speed.

Combined sampling of stations by camera/video and beam trawls, together with the taxonomic expertise on board, proved extremely useful in identification of fauna seen in images and video. The video material will be analysed to identify species and estimate abundances using stills capture from the videos. Stills will be annotated using the online BIIGLE platform which was designed for reviewing and annotating benthic imagery.

Beam trawls and bycatch

Beam trawls in general reflected species composition seen in the area by video observations. Benthic biomass was in generally lower than in shallow (on-shelf) areas surveyed in the June 2017 survey. There was limited benthic bycatch from Alfredo trawls in terms of biodiversity and biomass. It was mostly dominated by jellyfish (*Periphylla periphylla*, *Atolla wyvillei*), sponge fragments (*Asconema foliatum*), shrimps (*Acanthephyra pelagica*, *Pasiphaea* spp.), *Gonatus* spp. and occasionally bamboo corals (*Acanella arbuscula*), echinoderms (most often *Ophiomusiom lymani* and *Phormosoma placenta*) and large octopus (Cirrotheutidae).

At station 82 (Southeastern region of fig 1), the Alfredo trawl failed but brought up a large amount of sponges, *Geodia* spp. (fig. 7). Another mentionable bycatch consisted of many large seapens (*Halipteris finmarchica*) at station 9 (Northern region fig 1).

Figure 7: Left, Bycatch of sponges in the Alfredo trawl at station 82. Right, Large seapens (*Halipteris finmarchica)* caught in Alfredo trawl at St 9, 628 m.

Conclusions

Video and beam trawl surveys were successfully conducted at 31 stations, covering areas of high and low trawling impact. There was a clear distinction between trawled and untrawled areas, with frequently observed trawl marks and reduced diversity in the latter. The cup coral *Flabellum alabastrum* was widespread, but observations of seapens, sponges and branching corals were predominantly restricted to untrawled areas.

Due to severe weather conditions, only 39 of the 48 hours allocated to benthic sampling were used.

Appendix I

Table 1: Video and beam trawl survey station data

#	Date	Ship time (hh:mm) Used	Ship time (hh:mm) Total	Tow time (UTC) Start	Tow time (UTC) End	Midpoint (Decimal degrees) Latitude (N)	Midpoint (Decimal degrees) Longitude (W)	Gear	Video?	Mean depth (m)	Mean speed (knots)
1	11/10/2017	02:05	02:05	11:29	11:44	64.1574	54.7833	Beam	N	1063	1.62
2	13/10/2017	01:20	03:25	12:53	13:08	65.2620	57.6808	Sled	Y	649	1.88
3	14/10/2017	01:09	04:34	01:26	01:41	65.1210	55.7472	Sled	Y	823	1.86
4	14/10/2017	01:17	05:51	10:04	10:14	64.8035	56.4741	Beam	Y	719	1.40
5	14/10/2017	01:10	07:01	20:10	20:25	64.5425	57.0266	Sled	Y	828	1.26
6	15/10/2017	01:09	08:10	04:58	05:13	64.5147	56.1098	Sled	Y	908	1.10
7	15/10/2017	01:10	09:20	17:38	17:53	64.3859	55.5287	Sled	Y	1051	1.20
8	15/10/2017	01:15	10:35	22:54	23:09	64.1391	55.4755	Sled	Y	1103	1.24
9	16/10/2017	01:15	11:50	10:24	10:30	63.8423	55.9235	Beam	Y	1040	0.90
10	16/10/2017	01:00	12:50	15:21	15:36	63.7844	55.8241	Sled	Y	1150	0.96
11	16/10/2017	01:12	14:02	18:55	19:10	63.7951	56.4158	Sled	Y	1089	0.96
12	17/10/2017	01:17	15:19	00:23	00:38	63.8563	57.2191	Sled	Y	1183	0.64
13	17/10/2017	00:59	16:18	09:48	09:53	63.8596	57.5238	Beam	Y	1180	1.10
14	17/10/2017	01:20	17:38	13:59	14:14	63.8089	57.3577	Sled	Y	1261	1.14
15	17/10/2017	01:17	18:55	20:07	20:22	63.7846	57.8238	Sled	Y	1250	0.90
16	18/10/2017	01:30	20:25	02:35	02:50	63.6780	57.0665	Sled	Y	1476	1.08
17	18/10/2017	01:07	21:32	06:25	06:40	63.7147	56.8557	Sled	Y	1356	1.04
18	18/10/2017	01:20	22:52	12:54	12:59	63.5653	56.0648	Beam	Y	1267	0.90
19	18/10/2017	01:05	23:57	17:47	18:02	63.4378	55.9798	Sled	Y	1191	1.10
20	18/10/2017	01:15	25:12	19:23	19:38	63.3550	56.2094	Sled	Y	1409	1.14
21	19/10/2017	01:10	26:22	01:42	01:57	63.4253	55.7030	Sled	Y	1399	0.92
22	19/10/2017	01:25	27:47	07:37	07:42	63.5393	55.2062	Beam	Y	1148	1.10
23	19/10/2017	01:10	28:57	13:53	14:08	63.4191	54.7629	Sled	Y	1129	0.72
24	19/10/2017	01:10	30:07	16:20	16:35	63.3549	55.2585	Sled	Y	1337	1.10

25	19/10/2017	01:00	31:07	22:23	22:37	63.2724	54.9068	Sled	Y	1301	0.96
26	20/10/2017	01:13	32:20	05:30	05:45	63.1824	54.2776	Sled	Y	1300	1.22
27	20/10/2017	01:15	33:35	08:57	09:02	63.1083	54.0655	Beam	Y	1433	1.10
28	20/10/2017	01:09	34:44	12:38	12:53	63.2696	53.7408	Sled	Y	1102	1.00
29	20/10/2017	01:25	36:09	19:03	19:18	63.3498	54.2786	Sled	Y	1144	1.15
30	21/10/2017	01:10	37:19	02:14	02:19	63.4764	54.3773	Beam	Y	1133	0.90
31	21/10/2017	01:40	38:59	05:53	06:08	63.5349	54.2826	Sled	Y	1104	1.08