Cruise report
FRV "Walther Herwig III"
Cruise 373
01.03. – 23.04.2014

Studies on the Occurrence and Frequency of Eggs, Larvae and Adult European Eels in the Sargasso Sea

Cruise leader: PD Dr. Reinhold Hanel

The 373rd cruise of the Walther Herwig took the vessel for the second time since 2011 to the central Sargasso Sea to carry out studies on the distribution and abundance of the early development stages of the European eel (*Anguilla anguilla*). The core study area ranged from 30° - 24.5°N and 70° -49°W with stations being sampled along north south transects with an Isaacs-Kidd Midwater Trawl (IKMT). Additionally, seven other IKMT stations were sampled between the core study area and the Azores.

The primary objectives of this cruise were the documentation of the distribution and abundances of fish larvae and leptocephali with a focus on the two species of the genus *Anguilla* and also to provide further delineation of the spawning area of the European eel. The study also planned to gather more understanding of the influence of abiotic factors on the spawning behavior of eels and the distribution of early life stages. For this purpose, a set of oceanographic data was gathered in addition to the use of the IKMTs to catch fish larvae and zooplankton. Together with the results of the 342nd voyage of the Walther Herwig III in 2011, the results of this cruise were meant to provide insights into possible changes in the leptocephalus assemblage of the Sargasso Sea and to shed light on the influence of varying hydrographic conditions on the presence of early life stages. For this purpose, as in 2011, all caught leptocephalus larvae were sorted out of the catch, identified, measured and preserved.

In order to study the accompanying fauna in the spawning area of the European eel, a pelagic trawl was used. The net was equipped with a multi-closing system that made a stratified sampling of the water column possible, whereby the changes due to depth of the nekton community could be documented. During the entire cruise hydroacoustic data were documented. A combination of the hydroacoustic data with the catches from the pelagic trawl will provide information on the abundance, distribution and composition of the nekton in the studied area.

To sample plankton from the upper water layers, a 200 µm Apstein net was used. A later analysis of these samples in cooperation with the University of Hamburg and the University of Stockholm will provide information on phytoplankton community and micro plastic particles.

Distribution List:

BMEL Ref. 613/614
BLE, Ref. 523
Schiffsführung FFS Walther Herwig III
TI, FI
TI, SF
TI, OF
TI – Präsidialbüro (Michael Welling)
TI-Reiseplanung Forschungsschiffe (Dr. Norbert Rohlf)
Personalrat
MRI, Institutsteil Fisch
Deutscher Fischerei-Verband e.V.
Bundesamt für Seeschifffahrt und Hydrographie
Helmholtz-Zentrum für Ozeanforschung, GEOMAR
Fahrtteilnehmer

The cruise

The Walther Herwig III left Bremerhaven for St. Georges Town, Bermuda, on 1 March 2014 without scientific staff on board. Despite unfavorable weather, St. Georges Town was reached on schedule on 15 March 2014.

By the evening of 15 March, all 12 members of the scientific crew were onboard and the staffing was complete. The same day, the Walther Herwig III was visited by colleagues of the Bermuda Department of Environmental Protection and by crew members of the FSS Dana. The voyage to the study area started from St. Georges Harbor at 8 a.m. on 17 March 2014.

The scientific work started upon arrival of the first station on 18 March 2014 at 6:30 p.m. Further work was carried out at stations with a latitudinal spacing distance of 0.5° along north south transects in the core study area. The distance between the transects was 3° longitude (Fig. 1). The basis for the updates on the station planning and the expansion of the transects were satellite photos of ocean surface temperatures and the daily on-site assessment of the hydrographic profile.

At all regular stations plankton sampling was conducted with an IKMT. This took place in the form of double oblique tows, in each case from the surface to 300 m depth. At selected stations, additional triple oblique tows were carried out down to 150 m in order to further study the occurrence of early development stages of eels. Additionally, at all stations a hydrographic profile was generated (CTD also including oxygen, turbidity and Chlorophyll-a measurements) down to a depth of 500 m. With the exception of Transect 1, additional stations at a distance of 0.25° were visited at which a further CTD profile was compiled down to 300 m depth, in order to improve the resolution of the hydrographic data. For the same reason, an additional 500 m CTD profile was compiled between transects at a distance of 1.5° longitude each. The pelagic trawl net was used at one station each in six of the seven north-south transects. The multi-sampler made it possible to fish in three defined depth-ranges (Fig. 2). Trawling took place at night at depths between 100 and 350 m and once during the day at a depth of 700 m. A further additional night tow at 52°W went down to a depth of 960 m. The Apstein Net (200 µm mesh size) was used at a total of 34 stations to vertically sample from a depth of 200 m up to the surface. The plankton samples obtained were preserved in ethanol. A detailed station list with all equipment used is provided in the Appendix.

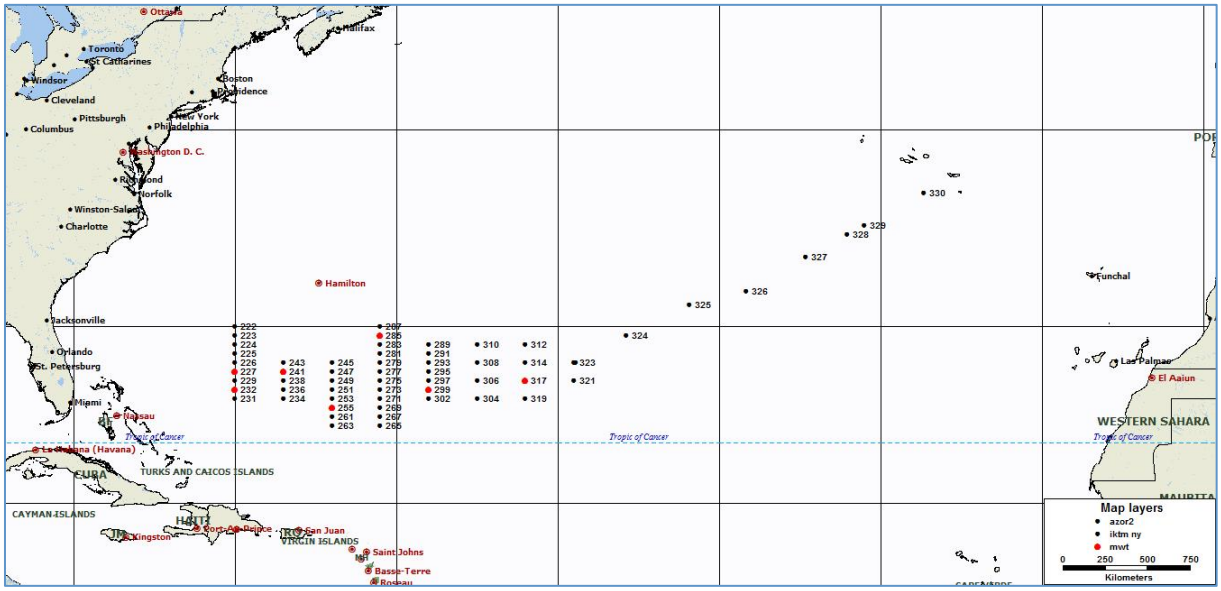

Fig. 1. IKMT Station grid. Stations at which pelagic trawl nets were used are marked in red. Additional CTD stations are not shown.

Fig. 2. Cod-ends of the pelagic multi-sampler used with the large trawl (Photo: K. Wysujack)

In order to sample as much of the study area to the east as possible, the distance in between the stations was increased to 1° in the last two transects and the number of stations was reduced. After conclusion of the last transect the Walther Herwig III left the core study area in the direction of Ponta Delgada, Azores. On the way to the Azores, seven additional stations were sampled with CTD casts and IKMT tows. Six of these IKMT tows were double oblique tows of down to 150 m depth and one was a single oblique tow to 700 m.

Directly following the IKMT tows during the whole survey, all preleptocephalus and leptocephalus larvae, as well as potential *Anguilla* eggs, were sorted out of the catches, identified and depending on how they would be used later, were either preserved in ethanol or frozen at -80°C or -20°C. In some individual cases, a RT-PCR was conducted onboard for identification of possible *Anguilla* specimens. Also mollusks and fish larvae were semi-quantitatively sorted out of the samples and preserved in ethanol as subsamples.

The scientific work was concluded on April 14, 2014 at 1 a.m. On April 14, 2014 the Walther Herwig entered the port of Ponta Delgada at 10 a.m. By April 16, 2014, eleven scientific crew members left the ship and the Walther Herwig III departed for Bremerhaven on April 16 at 9 a.m. The ship anchored in Bremerhaven on April 22, 2014 at 8:30 a.m.

During the 373rd cruise of the Walther Herwig III the following station work was carried out:

Isaac Kidd Midwater Trawl (500 µm mesh)	62 tows
CTD Probe	115 tows
Pelagic Fisheries Trawl (Multi-sampler)	7 tows
Apstein Net (200 µm mesh)	34 tows

First Results

During the cruise more than 3,000 leptocephalus larvae of different eel species (Anguilliformes) were caught and measured on board and identified to species level in most cases. The most frequent species were *Ariosoma balearicum* (Baleares conger, Bandtooth conger) and *Nemichthys scolopaceus* (Slender snipe eel), which together comprised more than half of all leptocephalus larvae. A total of 230 *Anguilla* preleptocephali or leptocephali were caught. Different samples were photographed (Fig. 3). For different reasons (e.g. physical damage) the identification to the species level was not possible for all the *Anguilla* specimens according to morphological criteria (myomere counts), so genetic analyses for species identification is currently being carried out at the Institute of Fisheries Ecology. All larvae of the *Anguilla* species were either stored at -80 °C or fixed in ethanol. The remaining larvae were mostly frozen at -20 °C or fixed in ethanol.

Fig. 3: Leptocephalus larvae of the *Anguilla* genus (Photos: M. Miller)

Based on the frequency of *Anguilla anguilla* and *Anguilla rostrata* larvae, an abundance comparison will be carried out compared to earlier studies (from the 1980s and the 342nd Voyage of the WHIII in 2011). Also the distribution of the *Anguilla* larvae with the prevailing hydrographic conditions was to be placed in context (Fig. 4). Additionally, the otoliths of the larvae will be removed in order to carry out daily ring counts and micro-chemical studies. After approval of the needed third party funding, the nutritional composition is to be analysed with genetic probes.

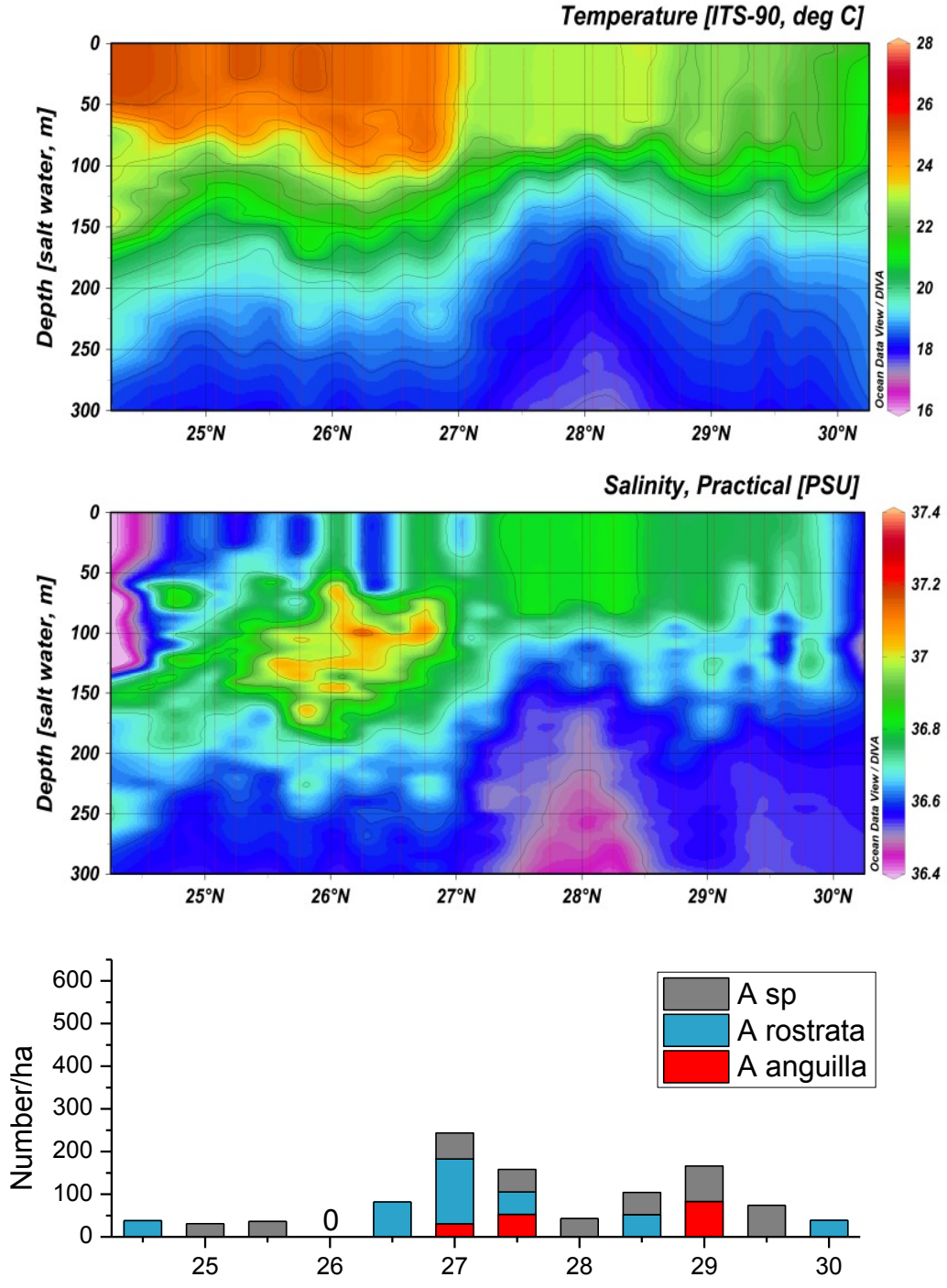

Fig. 4. *Anguilla* catches and temperature and salinity sections along the fourth Transect (61° W).

After the leptocephalus larvae were removed from IKMT catches the remaining plankton samples were fixed in ethanol for further studies. This is also true for the plankton samples obtained with the Apstein net.

The catches of the pelagic trawl nets were frozen at -20° C. The species identification and the measurement of the fish will be carried out at the Institute of Fisheries Ecology. Thus on the one hand, the pelagic fish species community and their depth stratification will be documented, on the other hand, the data will also make a detailed evaluation of the recorded hydroacoustic data possible. Identification and distribution analyses of cephalopods and other mollusks will be carried out in cooperation with the Helmholtz Centre for Ocean Research, Kiel.

Up to now 1044 squid and 1265 pelagic mollusks were taken out of the samples and fixed in ethanol (Table 1). Among the pelagic mollusks, between 41 and 43 different species were identified. Two of the species may also possibly each contain a further cryptic species, since 2 morphologically different groups could be observed within the assumed species. This requires genetic analysis in order to establish the exact identity of each animal. The species were distributed over 14 families within 4 orders (Fig. 5). By far most diverse order was the Thecosomata, to which 61.9% of the species belonged, followed by the Littorinmorpha (26.2%), the Gymnosomata (9.5 %) and the Nudibranchia (2.4%). Figure 6 shows some of the species caught. Further results, including exact quantitative analyses of the distribution patterns within the fronts as well as the genetic identification of the species will be examined in detail in the various laboratories.

Table 1. Diversity and number of collected Cephalopods and Gastropods.

Class	Order	Superfamily	Family	Number of Species	Number
Cephalopoda	-	-	-	-	1044
Gastropoda	Nudibranchia	Tritonoidea	Phylliroidae	1	3
	Gymnosomata	Clionoidea	Clionidae	1	58
			Pneumodermatidae	1	16
			Notobranchaeidae	2	11
	Thecosomata	Cavolinioidea	Cavoliniidae	9	317
			Cliidae	2	61
			Creseidae	4	118
			Cuvierinidae	2	80
		Limacinoidea	Limacinidae	3	36
		Cymbulioidea	Cymbuliidae	2	7
			Peraclidae	4	43
	Littorinimorpha	Pterotracheoidea	Pterotracheidae	1	139
			Carinariidae	1	25
			Atlantidae	8 bis 10	273

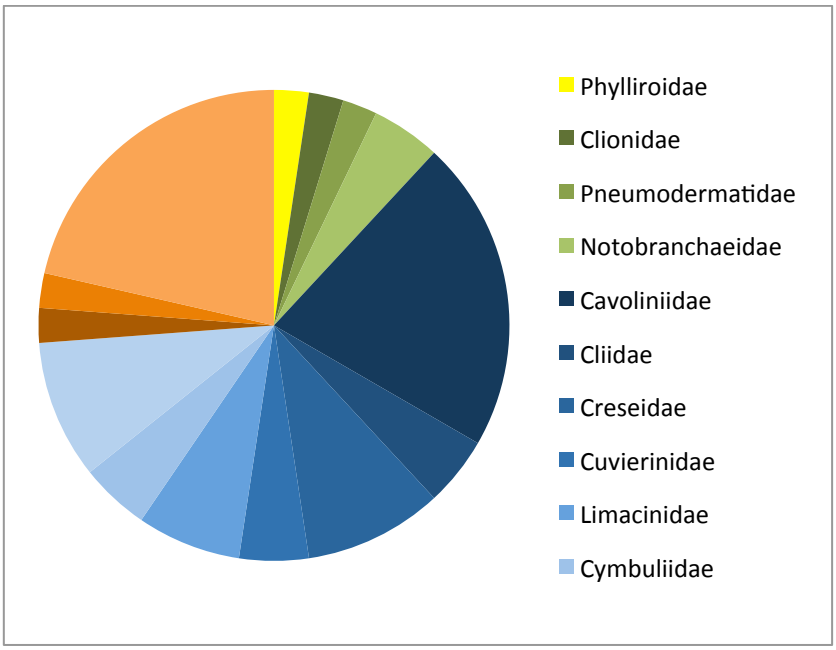

Fig. 5. Distribution of species by family and order. Yellow: Nudibranchia; Green: Gymnosomata; Blue: Thecosomata; Orange: Littorinimorpha.

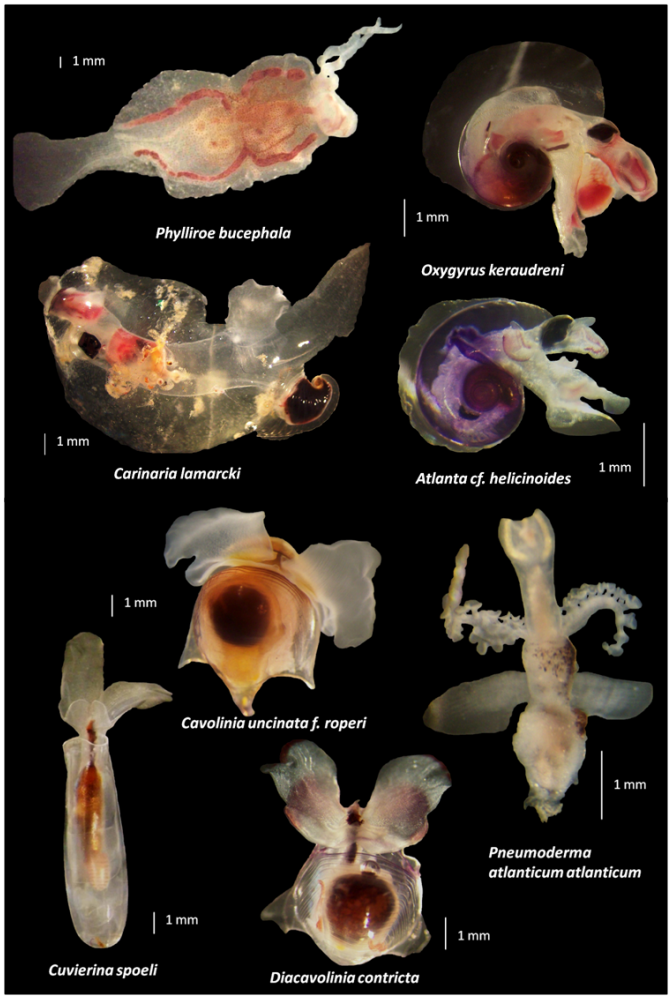

Fig. 6. Some characteristic species of pelagic mollusks found in the Sargasso Sea, showing representatives of the orders Nudibrancia (*Phylliroe*), Littorinimorpha (*Atlanta*, *Oxygyrus* and *Carinaria*), Gymnosomata (*Pneumoderma*) and Thecosomata (*Cavolinia*, *Diavavolinia* and *Cuvierina*).

Participants

01 PD Dr. Reinhold Hanel	15.03. – 16.04. TI-FI (cruise leader)
02 Dr. Klaus Wysujack	15.03. – 16.04. TI-FI
03 Dr. Lasse Marohn	15.03. – 16.04. TI-FI
04 Marko Freese	15.03. – 16.04. TI-FI
05 Jan-Dag Pohlmann	15.03. – 16.04. TI-FI
06 Tina Blancke	15.03. – 16.04. TI-FI
07 Katrin Unger	15.03. – 16.04. TI-FI
08 Prof. Katsumi Tsukamoto	15.03. – 16.04. Nihon University, Kanagawa, Japan
09 Dr. Michael J. Miller	15.03. – 16.04. University of Tokyo, Japan
10 Dr. Shun Watanabe	15.03. – 16.04. Nihon University, Kanagawa, Japan
11 Dr. Hakan Westerberg	15.03. – 16.04. Swedish University of Agricultural Sciences, Drottningholm, Sweden
12 Holger Ossenbrügger	15.03. – 16.04. Helmholtz Center for Ocean Research, Kiel, Germany

In the name of the scientific participants I would like to thank Captain Hans-Otto Janßen and his crew for their support and cooperation throughout the entire trip.

Dr. Reinhold Hanel

Appendix:

List of stations:

Station No	Position		Date	Time (UTC)		Gear
	lat (N)	long (W)		Start	End	
222	30 00.35	70 00.04	18.03.2014	18:30	21:49	IKMT 300m, CTD 500m, Apstein-Netz 200m
223	29 33.69	70 00.88	19.03.2014	00:37	03:52	IKMT 300m, CTD 500m
224	29 03.74	69 59.78	19.03.2014	06:11	10:01	IKMT 300m, CTD 500m
225	28 33.76	69 58.72	19.03.2014	11:38	15:40	IKMT 300m, CTD 500m, Apstein-Netz 200m
226	28 03.78	69 57.88	19.03.2014	17:45	21:25	IKMT 300m, CTD 500m
227	27 29.40	70 04.58	19.03.2014	23:39	02:13	IKMT 300m
228	27 30.02	69 59.60	20.03.2014	03:09	09:20	Pelagischer Trawl 350m, CTD 1000m, CTD 500m
229	27 00.94	69 58.87	20.03.2014	12:50	17:24	IKMT 300m, CTD 500m, Apstein-Netz 200m
230	26 33.16	69 58.95	20.03.2014	19:19	22:25	IKMT 300m, CTD 500m
231	26 03.23	69 59.52	21.03.2014	00:39	03:29	IKMT 300m, CTD 500m
232	26 33.24	69 59.02	21.03.2014	07:11	10:30	IKMT 90-150m, CTD 1000m
233	26 34.18	69 59.24	21.03.2014	11:17	18:19	Pelagischer Trawl 700m, CTD 1000m
234	26 57.80	66 59.35	22.03.2014	08:38	12:20	IKMT 300m, CTD 500m, Apstein-Netz 200m
235	26 15.02	67 00.01	22.03.2014	13:21	13:35	CTD 300m
236	26 27.05	67 00.18	22.03.2014	14:44	18:22	IKMT 300m, CTD 500m
237	26 45.08	66 59.85	22.03.2014	19:17	19:28	CTD 300m
238	26 56.61	67 00.09	22.03.2014	20:14	00:12	IKMT 300m, CTD 500m
239	27 14.98	67 00.05	23.03.2014	01:11	01:23	CTD 300m
240	27 30.11	66 59.81	23.03.2014	02:44	09:16	CTD 500m, Pelagischer Trawl 350m, CTD 1000m
241	27 28.17	67 01.25	23.03.2014	09:50	13:46	IKMT 300m, CTD 500m, Apstein-Netz 200m
242	27 44.99	67 00.01	23.03.2014	14:40	14:55	CTD 300m
243	27 57.03	67 02.57	23.03.2014	16:03	19:25	IKMT 300m, CTD 500m
244	28 00.03	65 30.02	24.03.2014	01:49	02:09	CTD 500m
245	28 02.18	64 03.65	24.03.2014	08:41	12:25	IKMT 300m, CTD 500m
246	27 45.15	63 59.79	24.03.2014	13:22	13:33	CTD 300m
247	27 33.42	64 00.13	24.03.2014	14:44	18:50	IKMT 300m, CTD 500m, Apstein-Netz 200m
248	27 15.03	64 00.07	24.03.2014	19:50	20:02	CTD 300m
249	27 04.01	63 58.58	24.03.2014	21:01	00:27	IKMT 300m, CTD 500m
250	26 44.95	63 59.95	25.03.2014	01:28	01:40	CTD 300m
251	26 34.26	63 58.42	25.03.2014	02:40	06:13	IKMT 300m, CTD 500m
252	26 15.01	63 59.87	25.03.2014	07:19	07:33	CTD 300m
253	26 03.08	63 58.61	25.03.2014	08:38	12:18	IKMT 300m, CTD 500m, Apstein-Netz 200m
254	26 45.05	64 00.03	25.03.2014	13:45	13:56	CTD 300m
255	25 33.03	63 57.96	25.03.2014	15:14	18:57	IKMT 300m, CTD 500m, Apstein-Netz 200m
256	25 31.98	64 01.10	25.03.2014	19:42	21:48	IKMT 80-150m, CTD 300m
257	25 37.33	64 00.83	25.03.2014	22:31	00:40	IKMT 80-150m, CTD 300m
258	25 34.68	64 01.08	26.03.2014	01:31	03:58	IKMT 80-150m, CTD 500m
259	25 33.96	63 55.56	26.03.2014	04:12	10:30	Pelagischer Trawl 350m, CTD 1000m
260	25 15.03	64 00.07	26.03.2014	11:30	11:43	CTD 300m
261	25 02.96	64 04.42	26.03.2014	13:00	16:40	IKMT 300m, CTD 500m
262	24 45.11	63 59.92	26.03.2014	17:53	18:06	CTD 300m
263	24 33.83	64 01.81	26.03.2014	19:23	23:12	IKMT 300m, CTD 500m, Apstein-Netz 200m
264	24 29.95	62 29.98	27.03.2014	06:07	06:30	CTD 500m

265	24 27.70	60 58.33	27.03.2014	14:03	18:02	IKMT 300m, CTD 500m, Apstein-Netz 200m
266	24 45.05	61 00.01	27.03.2014	19:22	19:35	CTD 300m
267	24 57.29	60 57.69	27.03.2014	21:03	00:38	IKMT 300m, CTD 500m
268	25 15.16	61 00.11	28.03.2014	01:48	01:59	CTD 300m
269	25 27.45	60 57.31	28.03.2014	03:18	06:40	IKMT 300m, CTD 500m
270	25 45.05	61 00.08	28.03.2014	07:45	07:57	CTD 300m
271	25 56.88	60 58.20	28.03.2014	06:15	13:10	IKMT 300m, CTD 500m, Apstein-Netz 200m
272	26 14.96	60 59.95	28.03.2014	14:13	14:27	CTD 300m
273	26 26.77	60 58.31	28.03.2014	13:48	19:30	IKMT 300m, CTD 500m, Apstein-Netz 200m
274	26 44.94	60 59.97	28.03.2014	20:39	20:52	CTD 300m
275	26 56.07	60 59.44	28.03.2014	22:02	01:41	IKMT 300m, CTD 500m, Apstein-Netz 200m
276	27 15.01	61 00.01	29.03.2014	02:55	03:10	CTD 300m
277	27 26.03	60 58.24	29.03.2014	04:24	07:16	IKMT 300m, CTD 500m
278	27 45.00	60 59.96	29.03.2014	08:40	08:56	CTD 300m
279	27 56.56	60 59.40	29.03.2014	10:05	13:07	IKMT 300m, CTD 500m
280	28 15.03	61 00.00	29.03.2014	14:14	14:27	CTD 300m
281	28 26.32	60 59.46	29.03.2014	15:33	18:31	IKMT 300m, CTD 500m, Apstein-Netz 200m
282	28 45.02	61 00.02	29.03.2014	20:07	20:21	CTD 300m
283	28 56.38	60 59.42	29.03.2014	21:30	01:05	IKMT 300m, CTD 500m, Apstein-Netz 200m
284	29 29.70	60 59.69	30.03.2014	02:38	02:49	CTD 300m, Pelagischer Trawl 350m
285	29 27.82	61 00.31	30.03.2014	08:45	13:07	CTD 1000m, IKMT 300m, CTD 500m, Apstein-Netz 200m
286	29 45.00	60 59.98	30.03.2014	14:05	14:16	CTD 300m
287	29 56.53	61 01.96	30.03.2014	15:22	19:23	IKMT 300m, CTD 500m, Apstein-Netz 200m
288	29 30.06	59 30.04	31.03.2014	03:38	03:59	CTD 500m
289	29 00.70	58 04.39	31.03.2014	11:54	15:40	IKMT 300m, CTD 500m, Apstein-Netz 200m
290	28 45.07	58 00.03	31.03.2014	16:53	17:09	CTD 300m
291	28 30.84	58 04.60	31.03.2014	18:40	22:51	IKMT 300m, CTD 500m, Apstein-Netz 200m
292	28 15.03	57 59.91	01.04.2014	00:18	00:30	CTD 300m
293	28 02.42	58 03.65	01.04.2014	01:51	05:30	IKMT 300m, CTD 500m, Apstein-Netz 200m
294	27 45.03	57 59.98	01.04.2014	06:54	07:36	CTD 300m
295	27 32.78	58 02.17	01.04.2014	08:53	12:22	IKMT 300m, CTD 500m, Apstein-Netz 200m
296	27 14.98	57 59.99	01.04.2014	13:50	14:15	CTD 300m
297	27 02.46	58 02.45	01.04.2014	15:37	18:56	IKMT 300m, CTD 500m, Apstein-Netz 200m
298	26 44.97	57 59.90	01.04.2014	20:15	20:30	CTD 300m
299	26 33.94	58 00.01	01.04.2014	21:30	01:00	IKMT 300m, CTD 500m, Apstein-Netz 200m
300	26 29.33	57 59.02	02.04.2014	01:31	08:43	CTD 500m, Pelagischer Trawl 350m, CTD 1000m
301	26 14.96	58 00.00	02.04.2014	09:52	10:11	CTD 300m
302	26 03.53	57 59.17	02.04.2014	11:12	15:16	IKMT 300m, CTD 500m, Apstein-Netz 200m
303	25 59.98	56 29.94	02.04.2014	23:01	23:22	CTD 500m
304	25 58.88	54 58.32	03.04.2014	06:34	10:15	IKMT 300m, CTD 500m, Apstein-Netz 200m
305	26 29.97	55 00.03	03.04.2014	13:02	13:15	CTD 300m
306	2700.37	5456.55	03.04.2014	16:22	20:08	IKMT 300m, CTD 500m, Apstein-Netz 200m
307	27 29.98	55 00.00	03.04.2014	23:27	23:44	CTD 300m
308	28 01.64	54 56.42	04.04.2014	03:10	06:46	IKMT 300m, CTD 500m, Apstein-Netz 200m
309	28 30.12	55 00.11	04.04.2014	09:49	10:01	CTD 300m
310	29 01.74	54 56.05	04.04.2014	13:15	13:37	IKMT 300m, CTD 500m, Apstein-Netz 200m
311	28 59.97	53 29.96	04.04.2014	23:39	23:59	CTD 500m
312	29 01.51	52 03.31	05.04.2014	06:33	10:10	IKMT 300m, CTD 500m, Apstein-Netz 200m
313	28 29.96	52 00.01	05.04.2014	12:45	12:58	CTD 300m
314	28 03.13	52 01.97	05.04.2014	15:20	18:59	IKMT 300m, CTD 500m, Apstein-Netz 200m

315	27 29.95	52 00.07	05.04.2014	21:07	21:26	CTD 300m
316	27 02.40	51 58.81	06.04.2014	00:44	12:57	CTD 500m, Pelagischer Trawl 1000m, CTD 1000m, Apstein-Netz 200m
317	26 58.47	52 00.19	06.04.2014	13:03	13:24	IKMT300, CTD 500m
318	26 30.11	52 00.05	06.04.2014	16:31	16:44	CTD 300m
319	25 56.74	52 00.13	06.04.2014	19:46	23:28	IKMT 300m, CTD 500m, Apstein-Netz 200m
320	26 29.90	50 30.21	07.04.2014	06:48	07:14	CTD 500m
321	26 58.24	48 59.69	07.04.2014	14:45	19:15	IKMT 300m, CTD 500m, Apstein-Netz 200m
322	27 30.10	48 59.99	08.04.2014	21:18	21:38	CTD 500m
323	27 57.77	49 00.80	08.04.2014	00:08	23:45	IKMT 300m, CTD 500m, Apstein-Netz 200m
324	29 26.41	45 41.85	08.04.2014	23:03	00:51	IKMT 150m, CTD 500m
325	31 09.28	41 51.22	09.04.2014	22:45	00:35	IKMT 150m, CTD 500m
326	31 49.49	38 19.93	10.04.2014	22:00	23:46	IKMT 150m, CTD 500m
327	33 34.19	34 40.06	11.04.2014	22:02	00:05	IKMT 150m, CTD 500m
328	34 42.87	32 10.60	12.04.2014	13:22	16:46	IKMT 150m, CTD 500m
329	35 12.32	31 04.18	12.04.2014	21:42	23:41	IKMT 150m, CTD 500m
330	36 56.73	27 20.18	13.04.2014	21:00	22:23	IKMT 150m