Weekly Report, Leg 1 (01.04. to 05.04.2015)

Research Vessel *Maria S. Merian* left Pennos Wharf in St. George's, Bermuda as scheduled on 01.04.2015 at 9:00 o´clock after four hours of fuel bunkering in the dockyards. With a strong breeze she steamed from Bermuda towards the first sampling station on our westernmost transect at 70°W, 30°N.

The first trial run of all sampling gear was successful except for the CTD probe (Figure 1), which due to some defect showed strong deviations from the expected temperature and salinity data. After intensive efforts and various steps to repair the probe, the problem could be solved and all data were successfully recalibrated. The deployment of the multinet, the two Isaaks-Kidd midwater trawls (0.5 and 5 mm mesh size) (Figure 2), the 1 m^2 MOCNESS (Figure 3) and Manta trawls worked fine, although is was decided to run the IKMTs from the stern instead of the starboard side.

The cooperation with the ship´s crew is excellent. Station planning follows the programme suggested in the ship´s research proposal and is carried out in close communication with the captain and scientists.

Each station of the first transect includes the deployment of a CTD and an IKMT. In addition, MOCNESS and multinet, respectively, as well as the 5-mm IKMT are used alternatively at two neighbouring stations.

The Manta trawl may be deployed parallel to other trawled gear, captain permitting. The tedious sorting of the plankton samples of all gears is carried out directly after each catch.

On April 4 we started sampling pelagic macroalgae of the genus *Sargassum* as well as drifting plastic litter. The deployment of the Zodiac required for this action benefitted from fine weather conditions and was performed smoothly. Additional samplings of drifting litter from the Zodiac are planned for the next days.

One major aim of the expedition is the sampling of *Leptocephalus* larvae of the Atlantic eels. So far, this objective was carried out successfully. Until Sunday at noon a total of 251 *Leptocephalus* larvae was collected and identified, 24 of them larvae of the American eel (*Anguilla rostrata*).

Overall, the sampling programme is according to time schedule and will continue as planned.

All people on board of RV *Maria S. Merian* are fine and wish everybody at home Happy Easter Holidays!

Reinhold Hanel & Willy Hagen

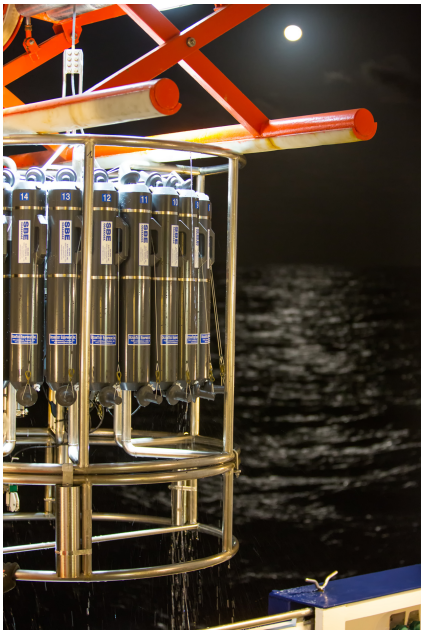

Figure 1: Conductivity Temperature Depth (CTD) Probe

Figure 2: Deployment of the 0.5 mm mesh size Isaaks-Kidd Midwater Trawl (IKMT)

Figure 3: Deployment of the 1 m^2 MOCNESS

MERIAN MSM41

Weekly report 2 (06.04. to 12.04.2015)

In addition to the plankton sampling programme major additional objectives of the survey are the exploration of the marine litter colonising community in the Atlantic garbage patch as well as investigations on the ecology of the *Sargassum* seaweed community.

Since our departure from Bermuda harbour flotsam was quantified visually during daytime on transects parallel to the ship. In addition to floating seaweeds of the genus *Sargassum*, flotsam in the Sargasso Sea region mainly consists of plastic litter. Until Saturday 11.04.2015 the abundance of seaweeds and flotsam was counted on a total of 28 transects. The amount of floating litter, which was encountered on each transect, was considerable in this offshore oceanic region. An average of 37 litter items per km^2 was counted, with a maximum of 98 items per km^2, which corresponds to densities in European coastal regions. Densities on the eastern transect were consistently higher than on the western transect indicating that litter densities may increase towards the centre of the subtropical gyre (Figure 1). Small fragments, which constitute the degradation products of larger items, constitute the major type of floating plastics.

The contamination of the region by plastic debris was confirmed by collections of microplastics from the sea surface using the Manta trawl (Figure 2). Considerable numbers of microplastics were collected during each operation of the Manta trawl.

Specific flotsam items were collected from the sea surface during operations of the Zodiac in order to study the associated species communities (Figure 3). The collection of floating objects is substantially supported by the very careful observation of the crew. A diverse community of organisms was found on floating *Sargassum*. Until now, a total of 35 rafting species could be identified. Species on floating litter are preserved for later analysis.

The Zodiac was also used to collect individuals of *Sargassum natans* at specific stations for a latitudinal comparison of the physiological algal status. Until today, algae were sampled at five stations (24°N to 30°N). This was always carried out with great support of the crew. On board of *Maria S. Merian*, pulse amplitude in vivo variable chlorophyll *a* fluorescence of photosystem II was measured with a pulse amplitude-modulated fluorometer (Diving-PAM). Moreover, samples were shock-frozen for later analysis of photosynthetic pigments, antioxidants and phlorotannins, which will be carried out in the laboratories of the University of Bremen.

Whenever possible larger amounts of *Sargassum natans* were collected at specific stations to monitor the physiological status of the algae in comparative temperature-stress experiments (+5°C, ambient and -5°C). Since it was not possible to run more than a single temperature treatment per day, algae were stored on deck in flow-through tanks. Despite the great effort of the crew (different positioning of the tanks: shade and sun; different flow-through systems etc.), it was not possible to maintain the physiological status of the algae from the field. After only one day the algae became darker in color, possibly due to accumulation of light-harvesting pigments (Figure 4), and displayed a drop in the fluorescence signal. Therefore, it was not possible to compare the algal reactions in the experiments, so that we decided to focus rather on the above described latitudinal comparison of the physiological status.

Due to ideal weather conditions the sampling proceeds as originally scheduled. The crew of the Maria S. Merian wishes a nice weekend!

Reinhold Hanel und Willy Hagen

MERIAN MSM41

Weekly report 3 (13.04. to 19.04.2015)

A research team from the Universities of Bremen (BreMarE) and Madeira as well as the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven investigates the productivity, the food web and predator-prey relationships in the Sargasso Sea, which ultimately also determine growth and developmental success of the eel larvae.

Due to the high sea surface temperatures of 22°C in the North and 26°C in the South of our investigation area, there is a pronounced permanent thermocline separating the surface waters from colder water masses with higher densities at greater depth. This barrier prevents the transport of nutrients necessary for algal growth from deeper layers into the surface layer with high solar radiation.

This nutrient deficit strongly limits the primary production of microscopically small unicellular algae (phytoplankton, e.g. diatoms, dinoflagellates, Figs. 1-3), which results in a very limited food supply for the zooplankton. Maximum densities of the algae are not - as usually - concentrated at the surface, but occur in 120 to 140 m depth. There is still sufficient light down there due to the extremely clear water of the Sargasso Sea and more nutrients are available in this depth layer than near the surface. Very small algae with a size of 0.02 mm and smaller play a crucial role in this layer.

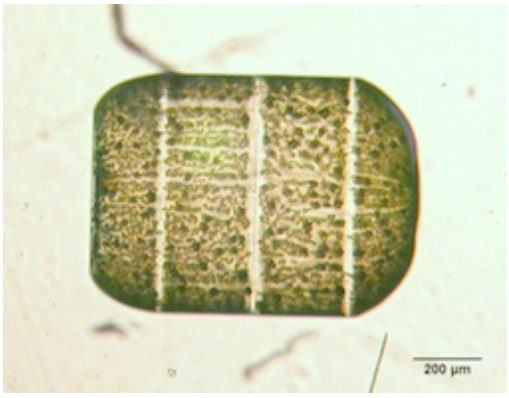

Fig. 1: Diatom *Ethmodiscus gazellae* (Photo M. Kaufmann).

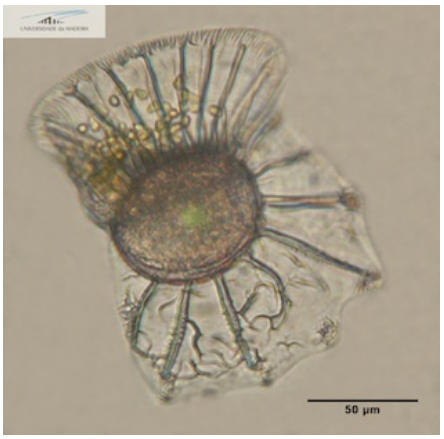

Fig. 2: Dinoflagellate *Ornithocercus* sp. (Photo M. Kaufmann).

Fig. 3: Dinoflagellate *Ceratium* sp. (Photo M. Kaufmann).

Water samples are collected from different depths by the rosette sampler to investigate the phyto-plankton. Several litres of seawater are filtered through very fine filters, which are later analysed for various pigments to elucidate the composition of the phytoplankton community (Fig. 4).

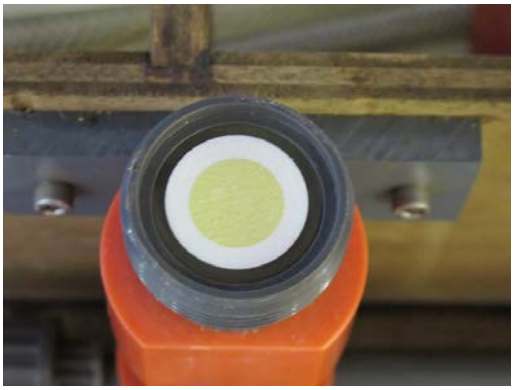

Fig. 4: Green-coloured filter after filtration of several litres of seawater (Photo M. Kaufmann).

Cyanobacteria dominated the surface phytoplankton at the southernmost stations between 24° and 22.5°N. These microorganisms have the unusual ability to utilize molecular nitrogen from the atmosphere as fertilizer for growth instead of nitrate, a successful strategy to cope with the general nutrient deficit in the “blue desert” of the Sargasso Sea.

Owing to the extremely limited food supply, zooplankton stocks are also very low compared to other regions. In particular copepods, which generally prevail in plankton communities with 50 to 80% of biomass globally, are rarely found in the Sargasso Sea. At the surface there are only minute copepods <1 mm. Biomass of our net catches is dominated by deep-sea shrimp (decapods, Fig. 5), myctophids and other deep-sea fish.

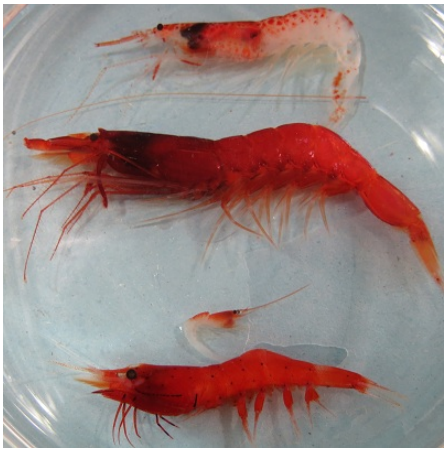

Fig. 5: Various decapod species, bottom: red deep-sea shrimp *Acanthephyra pelagica*, ca. 35 mm (Photo H. Auel).

Similar to the copepods, euphausiids (Fig. 6), often called krill, are found in much lower densities in the Sargasso Sea than in other regions of the Atlantic, but with higher species numbers. The catches comprise often less than a dozen individuals, but each animal may belong to a different species. However, at night several krill species concentrate in higher densities near the thermocline, where food accumulates, to "graze" and hunt for prey. Hence, the omnivorous krill may be a competitor for food but also a predator of the eel larvae.

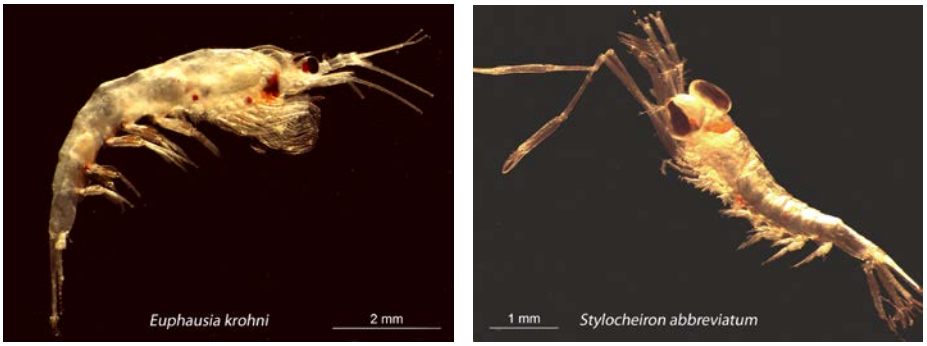

Fig. 6: Two of the 18 krill species with different feeding strategies encountered during MSM41 in the Sargasso Sea. *Euphausia krohni* filters the water for all kinds of particles, such as bacteria, phyto-plankton or small crustacean larvae, with a filtering basket formed by its thoracopods. *Stylocheiron abbreviatum* is equipped with two long thoracopods bearing chelae that are perfectly suited to catching prey organisms (Photo C. Buchholz).

The crew of the Maria S. Merian wishes a good start into the new week!

MERIAN MSM 41

Weekly report, Leg 4 (19.04. to 26.04.2015)

One of the primary objectives of the MSM41 sampling survey in April 2015 was to collect eel larvae, which are called leptocephali (**Figure 1**), of the Atlantic freshwater eels *Anguilla anguilla* (European eel) and also *Anguilla rostrata* (American eel), which spawn in the Sargasso Sea. The leptocephali of marine eels are also abundant in the Sargasso Sea and can be collected and compared to the abundances of anguillid larvae. Leptocephali were collected using the large mouth-opening IKMT pelagic trawl that has fine-mesh (0.5 mm) for catching all sizes of eel larvae and other planktonic organisms such as zooplankton and small fishes. A few leptocephali were also collected by the other smaller mouth-opening gear such as the MOCNESS depth sampling trawl and the Manta surface net. Leptocephali were immediately sorted out of the plankton samples and then identified on board using a dissecting microscope before being preserved in ethanol or frozen. Leptocephali were widely distributed across the study area and were collected at every station. In the first 4 transects, 301 *Anguilla* leptocephali ranging in size from 6.7 – 46.0 mm total length (average: 14.0 ±5.7 mm) were collected and 1354 marine eel leptocephali were collected (6 – 405 mm). The distributions and abundances of anguillid (131 *A. anguilla*, 133 *A. rostrata*, 37 *Anguilla* sp.; final species identification will be done using genetic sequences) and marine eel leptocephali (~36 species, 14 families) showed various different patterns in the transects of stations that sampled at a range of latitudes between 22.5°N and 31°N and from 70°W and 61°W. The leptocephali of the American eel were most abundant in the western and southwestern stations of the two western transects, and those of the European eel were most abundant in the middle or northern parts of the transects, but were rare in the westernmost transects and in the northernmost and southernmost stations (**Figure 2**). European eel larvae were 6.7 – 46.0 mm in size (average: 15.2 ± 4.5 mm), and American eel larvae were 9.8 – 36.3 mm (average: 17.2 ± 4.8 mm), with fewer larger leptocephali being collected. The larvae of the mesopelagic snipe eels (Nemichthyidae) were most abundant at the northern stations, and especially north of the frontal zone. Other abundant species such as the larvae of the congrid eel *Ariosoma balearicum*, were most abundant within the frontal regions of the more central parts of the transects. Small larvae of other mesopelagic species of the sawtooth eels (Serrivomeridae) and the gulper eels (Eurypharyngidae) were collected, which indicates these species were spawning offshore. However, the larvae of the other species of eels whose adults live in coastal areas, such as *A. balearicum*, other Congridae, Chlopisdae, Muraenidae, and Moringuidae were all large in size and had been transported offshore into the sampling area. The distributions, abundances and sizes of the *Anguilla* and other species of leptocephali will be analyzed in relation to the hydrographic structure and current flow patterns that were observed across the southern Sargasso Sea during the MSM41 oceanographic survey.

Fig. 1. *Photographs of eel larvae, called leptocephali, that were collected during the MSM41 research cruise in the Sargasso Sea showing (A) a 17.9 mm European eel, Anguilla anguilla, larva, (B) a 14.4 mm American eel, Anguilla rostrata, larva, (C) the head region of a 23.3 mm American eel larva, (D) the head regions of two types of Synaphobranchidae larvae, and (E) the leptocephali of a variety of eel families including the Congridae, Chlopsidae, Moringuidae, and Muraenidae. Scale bar is 2 mm in (A) and (B).*

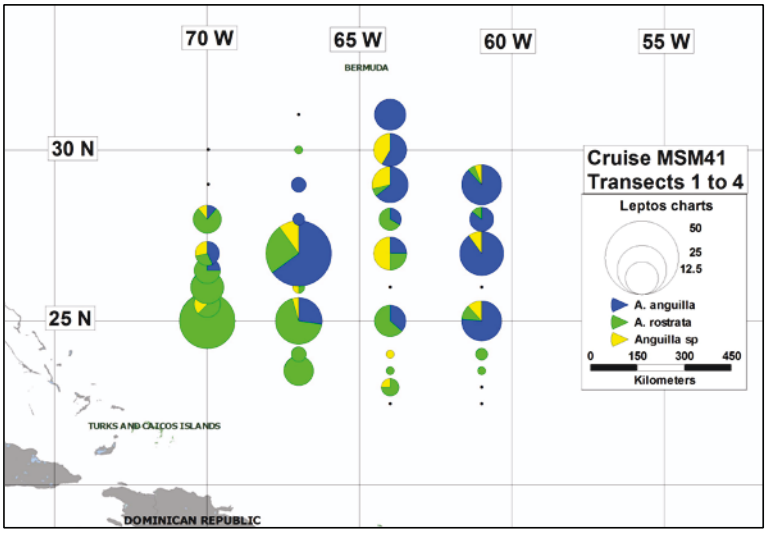

Fig. 2*. Map showing the number of leptocephalus larvae of the freshwater eels of Anguilla anguilla (European eel) and Anguilla rostrata (American eel) collected at each station of the first 4 transects during the MSM41 survey in the Sargasso Sea in April 2015 according to the morphological identifications onboard (counting of the number of myomere muscle segments), also showing the larvae that could not be distinguished to the species level (Anguilla sp.). The sizes of the circles indicate the number of anguillid larvae at each station. The fifth transect along 58°W is not shown.*

One of the most fascinating animal groups of the macroplankton of the Sargasso Sea are the early life stages of cephalopods. A working group of the GEOMAR Kiel investigates their

species diversity, abundance and distribution patterns in the research area on board during MSM41. The animals are directly sorted out from the IKMT trawls (0 – 300m), identified to the lowest possible taxon, photographed and measured. For further diet analysis, like the investigation of amino acids and stable isotopes, specimens are frozen, or fixed in ethanol for genetic analysis or in formalin for further functional morphological studies.

Up to now, more than 2000 specimens were sampled, representing at least 25 species of 15 different families. The distribution pattern seems to vary strongly between night and day catches. Furthermore, the subtropical convergence zone that has been found approximately between 27°N and 28°N during most transects seems to depict a significant faunal frontier for several species. The surface water temperature changes in those latitudes from approximately 22°C to 24°C from north to south. The early life stages of the fire squid, *Pyroteuthis margaritifera* (**Figure 3**) and species of the hooked-squids (family Onychoteuthidae) are so far the most abundant species of the investigated area .Some species like the glass squid *Leachia lemur* (family Cranchiidae) are only encountered in the northern water masses, whereas other squids of that family, for example *Helicocranchia papillata* (**Figure 3**), are distributed throughout the whole research area. The early life stages of the flying squid, *Hyaloteuthis pelagica* (family Ommastrephidae, **Figure 3**) tend to be more abundant in the southern stations.

The work on the ship is excellent and the material delivers new and broad insights into the distribution, taxonomy and diet of the early life stages of subtropical cephalopod species.

Fig. 3. *Selected cephalopods sampled with the IKMT during MSM41.*