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PRELIMINARY NOTE ON THE PUMP SAMPLES OF THE AMSTERDAM MID NORTH ATLANTIC PLANKTON EXPEDITION 1980 (PROJECT 101A) [1)]

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ABSTRACT

Pump samples filtered from the sea-water tap have been used to determine microplankton volumes, species diversity and faunal composition in the different water masses sampled by the Amsterdam Mid North Atlantic Plankton Expedition between 55°N 30°W and 24°N 30°W in the period 9 April - 6 May 1980. The presence of a plankton bloom south of 40°N could be demonstrated. Six faunal assemblages are distinguished, viz.: Subarctic, Cold Temperate, Warm Temperate, N. Sargasso Sea, S. Sargasso Sea and a more Tropical assemblage. Some traces of upwelling near 55°, 48° 38° and 30°N could be demonstrated by the presence of benthic Foraminifera in these shallow samples. A list of samples is provided.

INTRODUCTION

The pump samples studied in this paper were collected on board HnlMS "Tydeman" during the expedition between 55° and 24°N along approximately 30°W in the period 9 April - 6 May 1980 (fig. 1). Information on the net samples taken during the same cruise are given by Van der Spoel (1981). As an experiment the present samples were taken from a normal sea-water tap to provide microplankton material from the surface layers.

The results obtained with sampling from a sea-water tap on board the whale-factory ship "Willem Barendsz" in the season 1959/1960 (Van der Spoel et al., 1973) predicted acceptable results with this sampling method.

The aim of the present sampling was to provide an impression of the configuration of the surface water masses in the area investigated and of the fertility of the surface layers. The temperature-salinity relation, the plankton wet volume, the diversity and the faunal composition of the samples is discussed to elucidate the water mass configuration of the samples listed in Table I.

MATERIAL AND METHODS

The samples were taken from a normal so-called "clean" sea-water tap used to provide the laboratories with sea-water. The inlet of the pump

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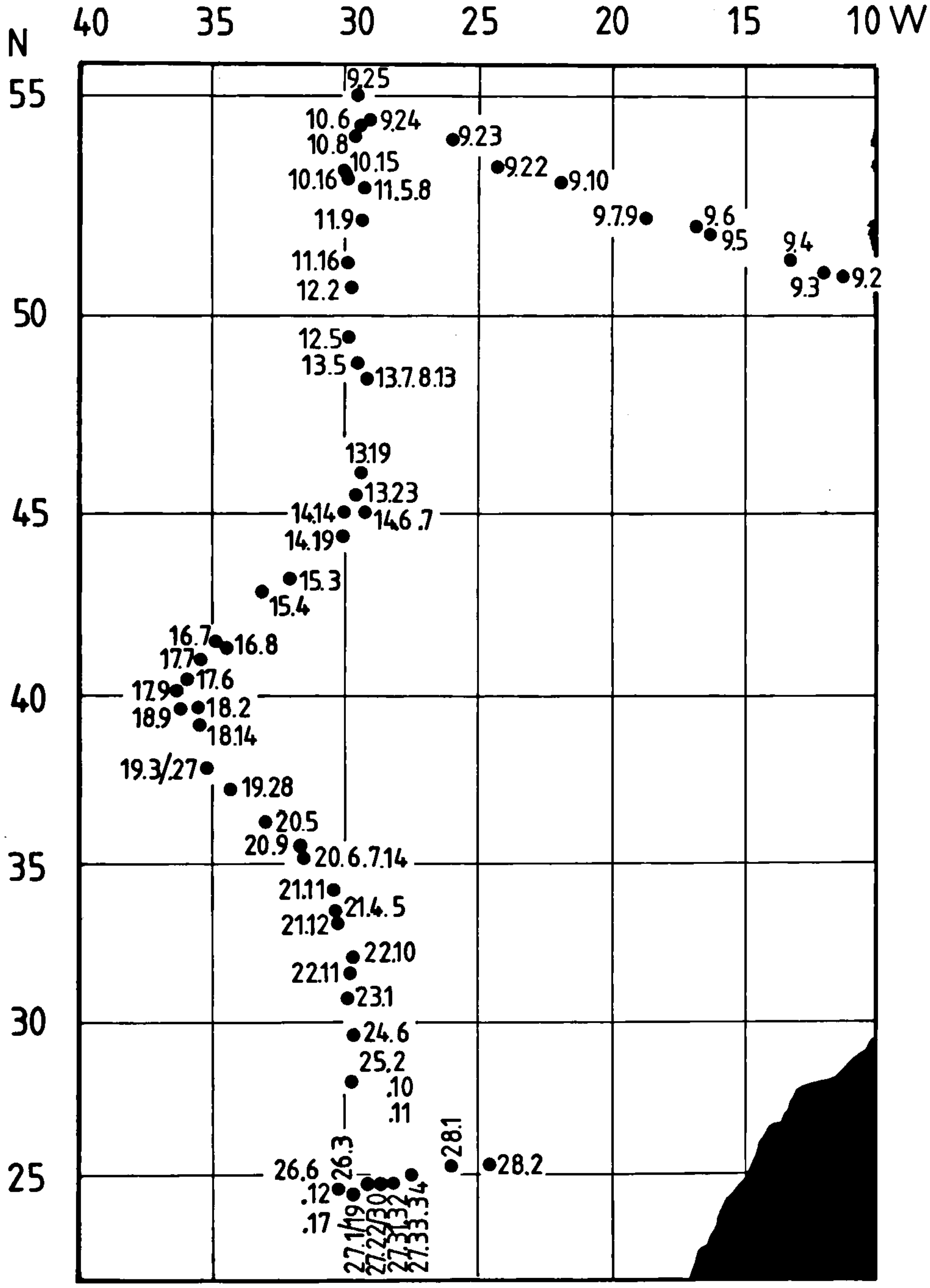

Fig. 1. Positions of the pump samples with station numbers before the point, and hauls behind.

system was 2.60 m below sea level. The water was filtered during 10 to 30 minutes, depending on the amount of plankton accumulated on the filter, through plankton cloth with a mesh size of 50 μm. The outflow of the tap with this gauze averaged 13.3 l per minute. All the samples were preserved in alcohol 70% after concentration in a centrifuge.

For each sample the amount of plankton was measured, as wet volume, by putting the sample in a calibrated cylinder glass and measuring the upper level of the sediment in the glass after 24 hours with an accuracy of 0.1 ml. Standard volumes per sample were computed giving the wet volume of plankton filtered from 240 litres of sea-water. This volume was taken as a standard being the average volume filtered during this expedition.

Microscopical slides for diatom studies and slides mounted in Euparal after treatment with alcohol 96% for the study of microzooplankton were made: these were studied and counted at a magnification of 120 x.

Table I lists the pump samples as a reference list also for future studies. The temperatures and salinities in table I were measured by the Ocean-log system of the research vessel also operating at a depth of 2.60 m.

RESULTS

For the pump samples of the cruise, the temperature-salinity (T/S) diagram (fig. 2) shows the Subarctic waters to lie between Stns 10 and 12, the Temperate waters between Stns 12 and 19 and the N. Atlantic Central water between Stns 21 and 26 (cf. Sverdrup et al., 1942). The Polar Front is found between Stns 11 and 12, in agreement with Van der Spoel (1981), The position of the Temperate waters also agrees with the T/S diagram and so do the N. Atlantic Central waters.

The plankton wet volume data (fig. 3) do not

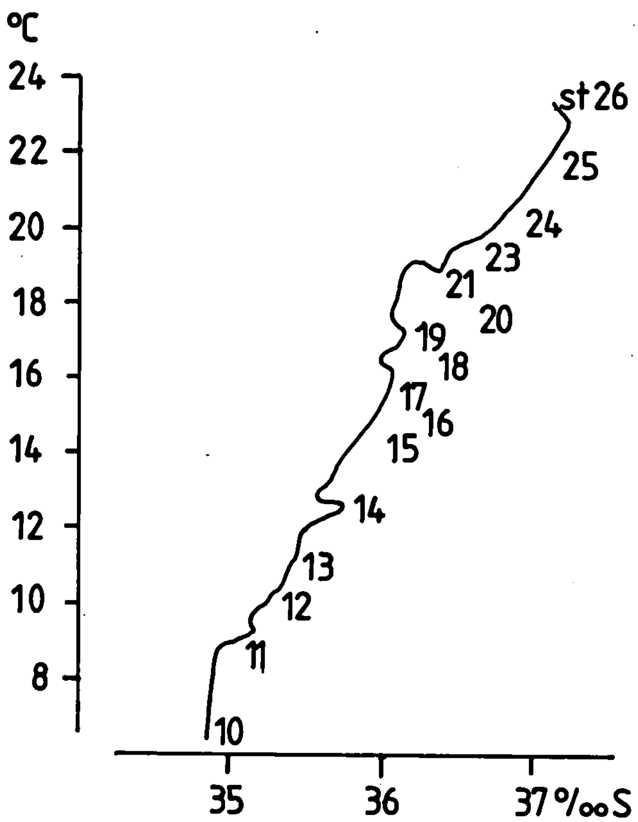

Fig. 2. Temperature (vertical axis)-salinity (horizontal axis) curve for the pump samples.

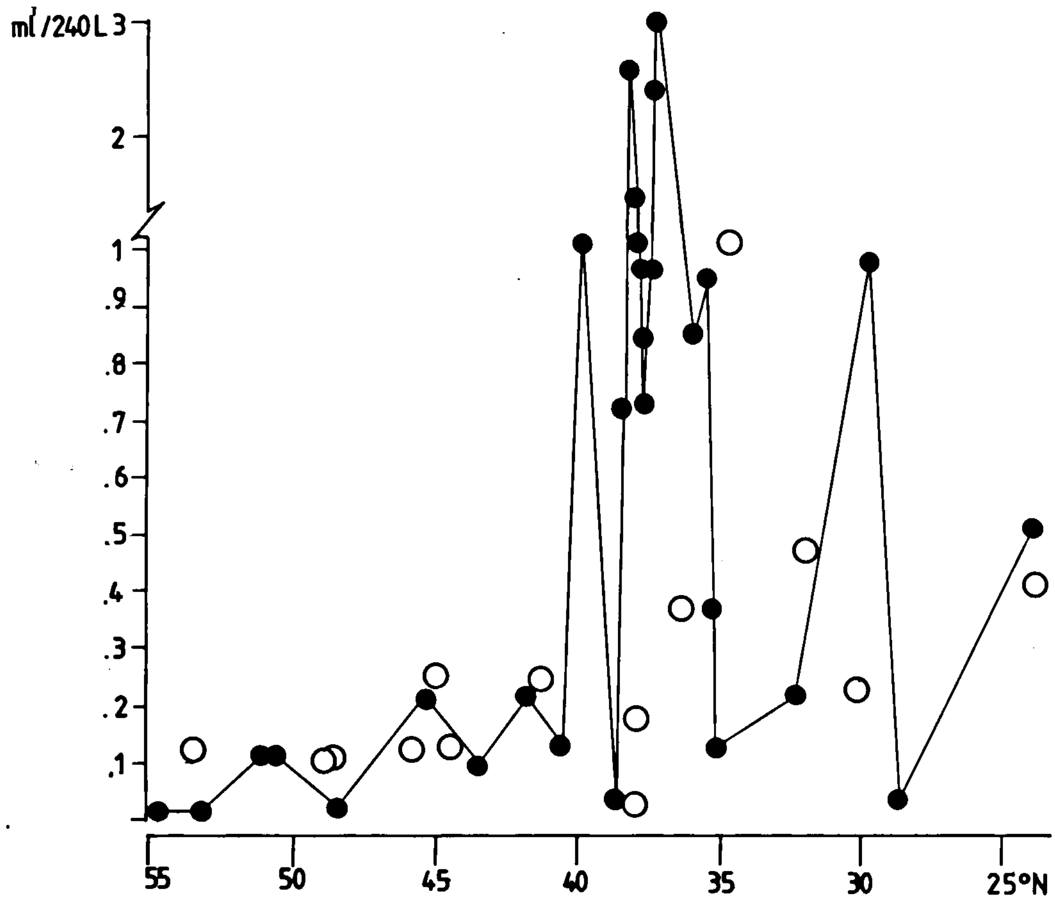

Fig. 3. Standard wet volumes of plankton in ml per 240 l of filtered sea-water; closed dots: day samples; open dots: night samples.

reflect the above hydrography. Near Stn 18 at 39°N the small plankton volumes of the higher latitudes are abruptly replaced by the larger volumes of the lower latitudes. The stations 10 to 18 (55°N - 40°N) all show small volumes (< 0.40 ml / 240 l seawater) probably due to the fact that the spring bloom had not yet started north of 40°N. Between Stns 17 and 20 (40° - 35°N) the largest volumes are found and near Stn 24 (30°N) a relatively high volume is recorded.

Between 40° and 35°N the thermocline just develops (Van der Spoel, 1981) while south of 35°N the shallow thermocline is constantly present. This coincidence confirms the hypothesis of a spring bloom between 40° and 35°N, while more to the south the real bloom has probably subsided already so that a steady state of summer production could be expected. The waters usually considered less productive, show, in this spring, higher productivity than the fertile waters in the north, where blooming is restricted.

In most samples the species diversity, expressed as dm/dv (= percentage of the most abundant species / number of species with abundances above 0.2%) fluctuates between 1 and 3. At Stn 17, dm/dv drops below 1 and at Stns 10, 11, 20, 21 and 22 it rises above 3. These maxima give no indication on the different water masses and they do not reflect the normal decrease in dm/dv towards lower latitudes.

The faunistic composition of the samples give more information as to the hydrographical composition of the area, the dm/dv values only marking the areas with mass microplankton blooms. *Dictyocha fibula* Ehrenberg, 1839 (fig. 4A) is abundant in the northern section of the cruise with a maximum at Stn 14, it characterizes the Temperate waters. The other peaks in the curve represent isolated populations of which the one at Stn 22 is the most abundant. *Distephanus speculum* (Ehrenberg, 1938) (fig. 4E) shows a distribution comparable to that of *D. fibula*, but a remarkable shift in the ratio of abundance of these two species is found from cold to warm waters (Table II). *D. fibula* is most abundant in warmer waters (> 11°C) and *D. speculum* is more abundant in cool water (<11°C). This was already mentioned by Martini (1977) who stated that *Dictyocha* shows an optimal range of 18 - 20°C and *Distephanus* has its optimum close to 0°C. According to Martini the reversal of the ratio between the two groups occurs in the range of 15 - 20°C while it is found near 11°C in the present material. This difference may reflect a typical spring situation.

Mesocena (fig. 4E 1) is a genus more typical of Temperate and warmer waters and its occurrence south of Stn 13 marks this.

Coccolithus (fig. 4G) shows high abundance between 55 and 40°N due to *C. pelagicus* (Wallich) Schiller and lower peaks south of 40°N effected by other species of the genus. *C.pelagicus* is a Subarctic species, restricted to and abundant between 65 and 40°N (Geitzenauer et al., 1977).

The dinoflagellates (fig. 4C) are of a nearly similar abundance in all the water masses. The Dinophysidae (fig. 4B) taken separately, however, show a higher abundance in the most northern waters. *Dinophysis caudata* Saville-Kent, 1881 and *Histioneis* occur from Stns 10 to 23 with the highest concentrations at Stns 10 and 11. The *D. ventrecta* Schiller, 1933-like forms occur from Stn 11 to 25 and *Ornithocercus* forms are restricted to the Stns 19 to 26. *D. caudata* and *Histioneis* characterize the colder and Subarctic waters north of 35°N, while *Ornithocercus* lives in the warm waters with the high plankton volumes south of Stn 18.

Benthic Foraminifera in the pump samples (fig. 4D) are usually associated with large amounts of fine sand grains. Stn 10 in Subarctic waters, Stn 13 near the Faraday Seamount, Stn 15 close to the Altair Seamount, Stn 19 near tops of the Mid Atlantic Ridge and Stn 24 close to the Great Meteor Bank provide this kind of samples and except for Stn 10 it is to be expected that large turbulences, such as upwellings around seamounts, bring material from the sediments into shallower layers.

The planktonic Foraminifera (fig. 4H) show a peak near Stn 19 and are absent near Stn 21. The fluctuation in percentages of Foraminifera are roughly parallel with the curve of plankton volumes (fig. 3) which is also shown by the maxima near Stn 19 (38°N).

Ciliata of the *Salpingella* and *Paraflavella* types (fig. 4F) are slightly more abundant between Stns 18 and 20.

Larval Crustacea (fig. 4J) show the same phenomenon, especially when the larger copepods are considered, which occur in large amounts in samples of Stns 14, 19 and 24. Larval Mollusca (fig. 4I) occur in two areas, one between 55 and 48°N and the other between 39 and 24°N. The high abundance in the northern waters is due to *Limacina retroversa* (Fleming,1823) larvae (Stns. 10, 11). In Stn 17 also *Limacina* larvae of the species *L. inflata* (D'Orbigny, 1836) dominate, while high abundances at Stns 20.21 and 23 are largely due to *Creseis* and probably also to *Styliola* larvae. At four stations (15, 18, 20, 21) Pneumodermatidae larvae, in embryonic shells, are found, as first described from fossils by Van der Spoel (1976). Prosobranchia larvae are found in all the samples taken at Stns 18 to 26.

The hydroids of the *Campanularia* type (fig. 4K) are most abundant in warmer waters and near Stn 18. These polyps may originate from the ship's hull or more likely from larger particles and organisms destroyed by the pump system.

Representatives of *Dictyocysta* show high abundances in cold water (Stn 15) where also Silicoflagellata are numerous. *Codonella galea* Haeckel occurs over the whole transect but it is most abundant near Stn 15. When *Codonella* is found together with representatives of the genus *Dictyocysta*, the ration *Codonella* versus *Dictyocysta* is lower when temperatures are below 15°C and higher when the temperature is higher. The cold-water preference of *Dictyocysta* is al-

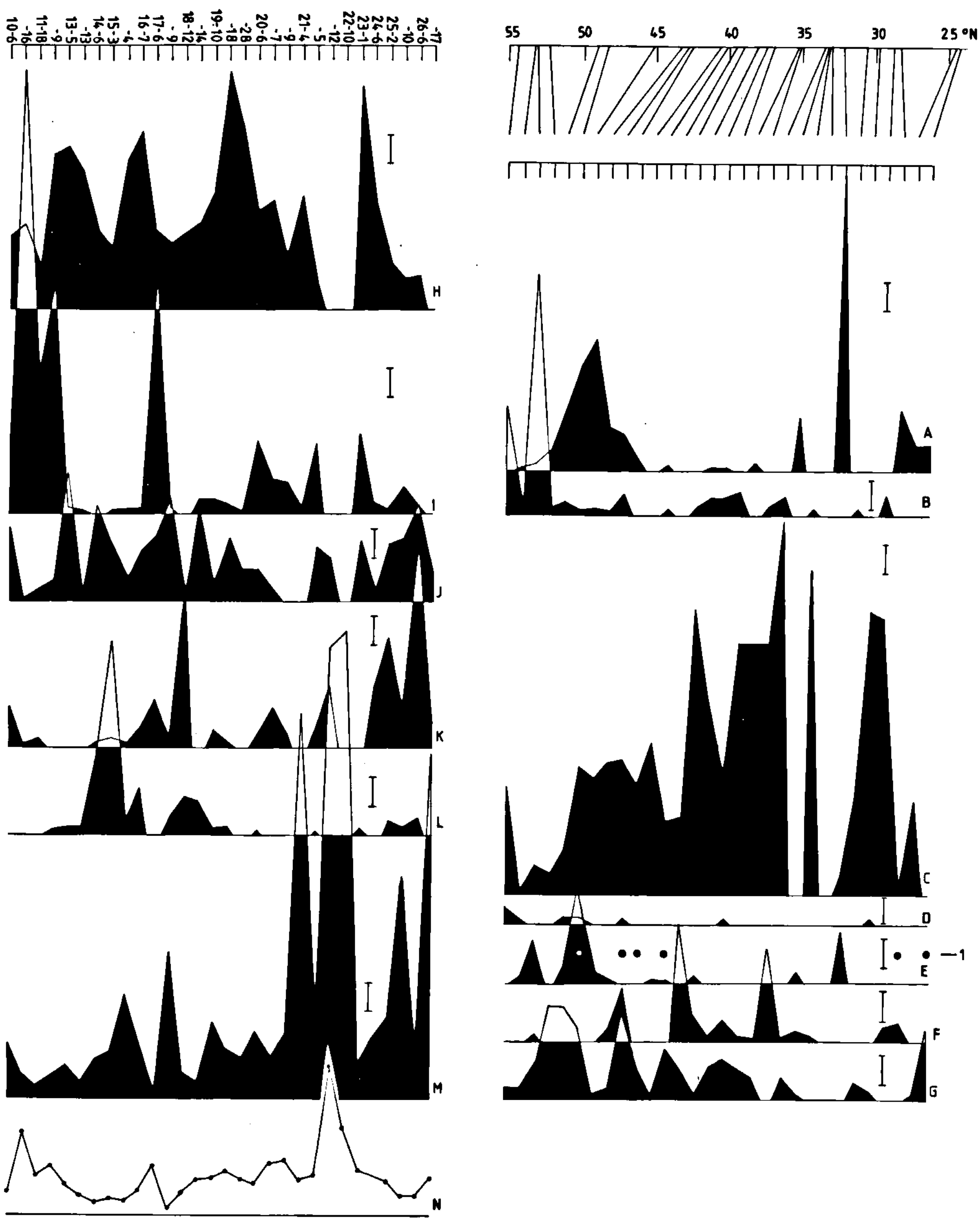

Fig. 4. Distribution of the different groups of microplankton along the transect. The horizontal axis gives the station-haul numbers and latitudes north, the vertical axis (scales represent 5%) gives the percentages of the total number of specimens counted per station-haul. Stn 19-10 stands for the hauls 10 to 17 of Stn 19; Stn 19-18 stands for the hauls 18 to 28 of Stn 19.
A: *Dictyocha fibula*, B: Dinophysidae, C: Dinoflagellata (except Dinophysidae), D: benthic Foraminifera, E: *Distephanus speculum*, E 1: Mesocena, F: Ciliata of the *Salpingella* type, G: Coccolithophoridae, H: planktonic Foraminifera, I: larval Mollusca, J: larval Crustacea, K: Hydrozoa, L: *Dictyocysta* and *Codonella* species, M: Radiolaria and Acantharia.

ready mentioned by Brandt (1906). This phenomenon is comparable with what has been described for the ratios of Silicoflagellata. *D. reticulatum* Kofoid & Campbell, 1929 occurs from Stn 12 to 19. *D. mitra* Haeckel, 1873 occurs from Stn 14 to 19 and *D. elegans* is restricted to Stn 17.

Very evident differences between Radiolaria and Acantharia faunas of the water masses have not been found. From north to south the species composition seems to change gradually and there is an increase in absolute abundance towards the lower latitudes. An extensive taxonomic study by the second author (in prep.) made it possible to distinguish the following ten faunal areas along the N-S transect.

1) Stn 9/ h.7-10/ h.6: 55°00.0'N 29°52.8'W to 54°46.8'N 29°52.8'W; 6.7 - 10.6°C; 35.07 - 35.64°/oo S.

In this area cold-water Radiolaria dominate and Acantharia are nearly absent; it can be considered a Subarctic area.

2) Stn 10/ h.8-11/h.9: 54°42.6'N 29°58.1'W to 52°27.3'N 29°57.3'W; 6.6-9.0°C; 34.96-35.21°/oo S.

Here Acantharia are still absent, and the Radiolaria fauna is comparable with that of the preceding area, but at Stn 10/ h.15 four species appear which also occur south of this area. This area, where radiolarian dm/dv values are decreasing for the first time (10.05-6.67), is considered to form a mixing-area near the Polar Front.

3) Stn 11/ h.16-14 /h.19: 51°18.1'N 30°01.5'W to 44°57.1'N 30°21.2'W; 9.7-13.2°C; 35.32-36.02°/oo S.

The radiolaria are represented by equal amounts of warm-water and cold-water species (such as *Trisulcus borealis* (Ehrenberg, 1872)). The first concentration of warm-water and eurythermous Acantharia (*Phyllostaurus cuspidata* (Haeckel, 1862) and *Acanthochiasma fusiforme* Haeckel, 1860 respectively) are found. This area can be considered to be of temperate nature with some influences of the North Atlantic Drift.

4) Stn 15/ h.3-15/ h.4: 43°37.1'N 32°22.9'W to 43°14.2'N 33°02.0'W; 14.2-14.5°C; 36.02-36.06°/oo S.

Most northern Radiolaria species reach here their southern borders, while the Acantharia of warmer waters show a steep increase in representatives. Typical Equatorial and Tropical species are encountered for the first time. This area can be considered the southern border of the Temperate waters.

5) Stn 16/ h.7-17/ h.6: 41°42.3'N 35°00.3'W to 40°34.2'N 36°04.9'W; 15.5-16.1°C; 36.16-36.31°/oo S.

The area is dominated by Radiolaria with a very wide north-south range and a few Acantharia. Mainly eurythermous and warm-water species are found. Though there is no typical representative of the N. Atlantic Drift in the assemblage, this area is still considered to represent N. Atlantic Drift water. This is also supported by the fact that some cold-water species occurring north of Stn 16/ h.7 are present again south of Stn 19/ h.3.

6) Stn 17/ h.9-19/ h.3: 40°02.3'N 36°21.4'W to 38°00.2'N 35°33'.7'W; 15.8-16.7°C; 36.17-36.45°/oo S.

Here a few more warm-water Radiolaria occur, a few cold-water species return and six Tropical-Subtropical Acantharia reach their northern limit in this area which may be considered a mixing area between N. Atlantic Drift and northern Sargasso Sea waters.

7) Stn 19/ h.8-21/ h.5: 37°18.6'N 34°35.8'W to 33°43.8'N 30°41.2'W; 16.7-19.2°C; 36.29-36.64°/oo S.

This area, considered to be the northern Sargasso Sea, is characterized by warm-water species, one cold-water species (*Protocystis xiphodon* (Haeckel, 1887)) and a few Temperate species; the Acantharia show high abundance.

8) Stn 21/ h.12-22/ h.11; 33°12.3'N 30°31.2'W to 31°44.5'N 29°58.8'W; 18,7-19.6°C; 36.60-36.69°/oo S.

Here all warm-water Acantharia, most warm-water and cold-water Radiolaria are found. It can be considered the southern Sargasso Sea.

9) Stn 23/ h.1-25/ h.11: 30°49.0'N 29°59.3'W to 28°05.2'N 29°59.6'W; 20.0-21.5°C; 36.84-37.13°/oo S.

No Acantharia are found in this area and the few Radiolaria show a typical Tropical-Subtropical assemblage. This area can be considered the periphery of the Sargasso Sea with neritic influences.

10) Stn 26/ h.3-27/ h.34: 25°06.3'N 27°20.1'W to 24°48.2'N 30°08.1'W; 22.1-23.7°C; 37.02-37.28°/$_{oo}$S.

The Acantharia are rare here but the Radiolaria show great diversity and abundance. *Collodaria* dominates this Subtropical area.

CONCLUSIONS

From the distributions of *Coccolithus pelagicus*, *Distephanus speculum* and *Limacina retroversa* larvae one can conclude that the influence of Subarctic waters on the fauna is traceable down to 40°N. The occurrence of benthic Foraminifera and sand grains in samples shows that transport of bottom material to the surface layers occurs near rises of the ocean bottom at Stns 13, 15, 19 at 24. The distribution of Prosobranchia larvae clearly markes the influence of the gyral current of the Sargasso Sea between 40 and 24°N (in the present transect Stns 18-26) (cf. Scheltema, 1971). The presence of *Dictyocysta* from 50° to 38°N indicates the presence of Temperate waters. Of the Dinoflagellata, *Dinophysis* and *Histioneis* have a wide distribution, only *Ornithocercus* marks the presence of Subtropical waters south of 38°N (cf. Sarjeant, 1974).

The Radiolaria, however, allow a finer subdivision of the area into ten faunas between 55 and 24°N.

Very remarkable in this cruise is the high plankton wet volume at Stn 19. In the whole area south of 40°N plankton volumes were higher than north of this latitude indicating that the spring-bloom had not started in April 1980 north of 40°N. Stn 21 (34°N), especially at haul 12, shows a remarkable zooplankton composition, completely dominated by Radiolaria and deprived of any other group. This haul was the poorest in total number of organisms.

In table III the water masses sampled are given with the faunal types as deduced from the entire microplankton. The borders between these larger faunas can be defined as follows:

a) The Subarctic/Cold Temperate transition is marked by the absence of Acantharia larvae, a decrease of Dinophysidae and *Limacina* larvae and an increase of Flagellata.

b) The Cold Temperate/Warm Temperate transition is marked by decrease of Silicoflagellata and a first increase of Radiolaria.

c) The Warm Temperate/North Sargasso Sea transition is marked by the first occurrence of Prosobranchia larvae, a second increase of Flagellata and the first occurrence of Prosobranchia larvae, a second increase of Flagellata and the first occurrence of warm-water species of Dinophysidae.

d) The North/South Sargasso Sea transition is marked by an evident second increase of Radiolaria, among which the Sargasso Sea assemblage is dominant.

e) The South Sargasso Sea/Subtropical-Tropical water transition is marked by the first occurrence of Tropical and Equatorial Radiolaria.

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Table I

List of filter samples taken from the sea-water tap.

ST: station number

HA: haul

DATE: day-month

CRE: average course of the ship during sampling

DU: duration of the sampling in minutes

TEMPE: sea-water temperature at start of haul

SALIN: salinity at start of haul

PER: period of the day; D: day sample, N: night sample, D/N: dusk sample, N/D: dawn sample.

ST	HA	DATE	POSITION		CRE	DU	TIME	TEMPE	SALIN	PER
8	1	10-04	49°47.4'N	05°55.8'W	261	10	16.47	10.50	35.38	D-N
8	2	10-04	49°51.3'N	06°54.7'W	290	10	19.46	10.30	35.38	D-N
8	3	9-04	-	-	-	10	6.56	-	-	D-N
8	4	10-04	50°09.7'N	03°01.4'W	259	10	8.01	8.70	35.20	D
9	2	11-04	51°01.0'N	11°39.7'W	289	10	14.56	10.90	35.62	D
9	3	11-04	51°09.5'N	12°19.2'W	289	10	17.01	10.80	35.66	D-N
9	4	11-04	51°23.7'N	13°26.3'W	289	10	20.30	10.70	35.68	D-N
9	5	12-04	52°08.2'N	16°40.3'W	286	10	6.57	10.70	35.69	N-D
9	6	12-04	52°12.0'N	17°01.0'W	290	10	8.07	10.80	35.69	D
9	7	12-04	52°39.5'N	19°11.9'W	198	19	15.57	10.40	35.60	D
9	9	12-04	52°37.5'N	19°07.5'W	-	12	20.55	10.60	35.64	D-N
9	10	13-04	53°16.9'N	22°09.2'W	293	23	8.15	9.20	35.40	D
9	22	13-04	53°49.7'N	24°39.3'W	290	20	16.53	7.70	35.14	D
9	23	13-04	54°10.5'N	26°05.9'W	293	18	21.16	7.50	35.10	D-N
9	24	14-04	54°53.1'N	29°22.7'W	286	18	6.46	6.80	35.13	N-D
9	25	14-04	55°00.0'N	29°56.5'W	236	30	8.30	6.50	35.10	D
10	6	14-04	54°46.8'N	29°52.8'W	209	30	17.09	6.70	35.07	D
10	8	14-04	54°42.6'N	29°58.1'W	266	30	22.00	6.70	35.06	N
10	15	15-04	53°29.5'N	30°01.1'W	182	30	7.00	6.60	34.99	N-D
10	16	15-04	53°13.5'N	30°01.5'W	177	30	8.24	6.60	34.96	D
11	5	15-04	53°06.0'N	29°53.6'W	345	35	17.30	6.70	34.99	D
11	8	15-04	53°06.0'N	29°56.4'W	187	34	21.51	6.70	34.96	N
11	9	16-04	52°27.3'N	29°57.3'W	179	30	1.15	9.00	35.21	N
11	16	16-04	51°18.1'N	30°01.5'W	178	30	7.03	9.70	35.32	N-D
12	2	16-04	50°58.0'N	30°00.8'W	179	30	9.26	10.30	35.53	D
12	5	16-04	49°57.7'N	30°00.1'W	176	30	17.15	9.70	35.43	D
13	5	16-04	49°04.7'N	29°59.4'W	180	30	21.55	11.30	35.69	N
13	7	17-04	48°58.7'N	29°32.8'W	97	30	5.58	10.80	35.62	N-D
13	8	17-04	48°59.6'N	29°25.6'W	94	30	6.56	11.00	35.64	N-D
13	13	17-04	48°36.6'N	29°15.2'W	189	30	17.30	12.00	35.70	D
13	19	18-04	46°01.6'N	29°54.5'W	186	30	6.59	12.60	35.98	N-D
13	23	18-04	45°53.4'N	29°55.5'W	186	30	7.40	12.60	35.98	N-D
14	6	18-04	45°10.5'N	29°50.5'W	29	48	18.40	12.70	36.02	D-N
14	7	18-04	45°16.6'N	29°29.5'W	29	152	21.18	12.70	36.02	N
14	14	19-04	45°02.2'N	30°13.1'W	226	30	6.47	13.00	35.88	N-D
14	19	19-04	44°57.1'N	30°21.2'W	226	30	7.24	13.20	35.88	N-D
15	3	19-04	43°37.1'N	32°22.9'W	221	42	17.23	14.50	36.06	D
15	4	19-04	43°14.2'N	33°02.0'W	230	30	21.57	14.20	36.02	N
16	7	20-04	41°42.3'N	35°00.3'W	165	32	15.13	16.10	36.31	
16	8	20-04	41°33.2'N	34°35.9'W	212	140	20.00	15.90	36.16	D-N
17	6	21-04	40°34.2'N	36°04.9'W	196	30	17.19	15.50	36.18	D
17	7	21-04	41°15.5'N	35°31.4'W	19	30	6.34	15.80	36.17	N-D
17	9	21-04	40°02.3'N	36°21.4'W	184	90	22.23	16.30	36.35	N
18	9	22-04	39°45.0'N	36°13.5'W	65	40	7.00	16.70	36.45	N-D
18	12	22-04	39°55.4'N	35°56.5'W	55	32	13.57	16.20	36.43	D
18	14	22-04	39°18.9'N	35°39.4'W	174	30	22.28	16.40	36.36	N
19	3	23-04	38°00.2'N	35°33.7'W	172	65	6.45	16.60	36.31	N-D
19	8	23-04	38°08.6'N	35°50.4'W	329	20	16.23	16.80	36.30	D
19	9	23-04	38°04.5'N	35°54.9'W	249	30	22.02	16.80	36.42	N

ST	HA	DATE	POSITION	CRE	DU	TIME	TEMPE	SALIN	PER
19	10	24-04	37°58.8'N 35°52.4'W	90	30	3.00	16.90	36.45	N
19	11	24-04	37°59.0'N 35°31.3'W	54	30	6.33	16.70	36.42	N-D
19	12	24-04	38°00.1'N 35°29.0'W	130	30	7.30	16.70	36.41	N-D
19	14	24-04	37°59.2'N 35°27.6'W	39	30	8.30	16.70	36.41	D
19	15	24-04	38°00.5'N 35°26.6'W	39	30	9.30	16.70	36.40	D
19	16	24-04	38°02.0'N 35°24.9'W	39	30	10.30	16.70	36.40	D
19	17	24-04	38°02.4'N 35°23.9'W	129	31	11.29	16.70	36.39	D
19	18	24-04	37°54.5'N 35°18.1'W	149	30	13.30	16.60	36.31	D
19	20	24-04	37°58.4'N 35°20.6'W	149	30	12.30	16.60	36.36	D
19	21	24-04	37°52.0'N 35°16.8'W	149	30	14.30	16.70	36.29	D
19	23	24-04	37°49.7'N 35°17.3'W	149	30	15.30	16.70	36.27	D
19	24	24-04	37°47.9'N 35°17.2'W	135	31	16.27	16.70	36.28	D
19	25	24-04	37°45.7'N 35°15.9'W	134	30	17.30	16.80	36.28	D
19	26	24-04	37°43.7'N 35°14.6'W	124	30	18.34	16.70	36.29	D-N
19	27	24-04	37°39.0'N 35°07.4'W	128	35	19.25	16.70	36.25	D-N
19	28	24-04	37°18.6'N 34°35.8'W	125	30	22.07	16.70	36.29	N
20	5	25-04	36°15.5'N 33°02.1'W	128	30	6.36	17.60	36.44	N-D
20	6	25-04	35°23.4'N 31°45.9'W	124	38	17.01	17.90	36.36	D
20	7	25-04	35°20.3'N 31°40.9'W	123	30	19.30	17.90	36.35	D-N
20	9	26-04	33°46.2'N 30°41.7'W	183	30	22.12	19.20	36.63	N
20	14	26-04	35°11.8'N 31°26.9'W	136	30	6.36	17.80	36.35	N-D
21	4	26-04	33°54.6'N 30°42.8'W	179	36	19.14	19.10	36.40	D-N
21	5	26-04	33°43.8'N 30°41.2'W	182	30	23.10	19.00	36.64	N
21	11	27-04	34°23.2'N 30°36.9'W	159	30	7.04	18.80	36.62	N-D
21	12	27-04	33°12.3'N 30°31.2'W	-	30	8.30	18.70	36.60	D
22	10	27-04	32°02.4'N 29°54.0'W	180	30	22.15	19.60	36.69	N
22	11	28-04	31°44.5'N 28°58.8'W	186	31	6.30	19.60	36.67	N-D
23	1	28-04	30°49.0'N 29°59.3'W	-	30	11.20	-	-	D
24	6	29-04	29°36.9'N 29°56.3'W	179	37	8.28	20.00	36.84	D
25	2	29-04	28°40.7'N 29°58.9'W	179	30	16.48	21.50	37.12	D
25	10	29-04	28°28.7'N 29°56.9'W	178	30	22.44	21.50	37.12	N
25	11	30-04	28°05.2'N 29°59.6'W	185	30	6.45	21.50	37.13	N-D
26	3	1-05	24°58.3'N 29°59.3'W	180	45	7.00	23.10	37.28	N-D
26	6	1-05	24°54.1'N 29°59.3'W	183	29	9.03	23.10	37.28	D
26	12	1-05	24°46.0'N 30°08.1'W	30	30	19.15	23.70	37.19	D-N
26	17	1-05	24°50.5'N 30°07.2'W	336	30	21.33	23.50	37.19	N
27	1	2-05	24°48.4'N 28°49.6'W	90	30	4.30	22.40	37.25	N-D
27	4	2-05	24°48.5'N 28°38.3'W	129	31	5.25	22.60	37.23	N-D
27	5	2-05	24°48.7'N 28°35.7'W	289	29	6.30	22.70	37.18	N-D
27	8	2-05	24°48.7'N 28°37.9'W	290	30	7.29	22.80	37.22	N-D
27	9	2-05	24°48.3'N 28°41.4'W	290	30	8.28	22.80	37.22	D
27	11	2-05	24°48.2'N 28°44.4'W	289	30	9.31	22.60	37.24	D
27	12	2-05	24°48.6'N 28°47.6'W	290	29	10.31	22.40	37.26	D
27	13	2-05	24°48.6'N 28°48.9°W	103	30	11.30	22.40	37.26	D
27	14	2-05	24°48.6'N 28°46.5'W	70	30	12.35	22.50	37.26	D
27	15	2-05	24°48.6'N 28°44.2'W	70	30	13.35	22.80	37.23	D
27	16	2-05	24°49.6'N 28°41.7'W	134	30	14.32	23.00	37.19	D
27	18	2-05	24°51.2'N 28°41.2'W	151	30	15.39	23.10	37.16	D
27	19	2-05	24°52.0'N 28°39.8'W	69	30	16.30	23.10	37.17	D
27	22	2-05	24°53.2'N 28°37.3'W	20	30	17.50	23.10	37.11	D-N
27	25	2-05	24°55.8'N 28°37.5'W	360	30	19.30	23.00	37.13	D-N
27	26	2-05	24°58.9'N 28°37.9'W	358	30	20.30	22.70	37.23	D-N
27	27	2-05	25°00.9'N 28°38.4'W	358	30	21.30	22.50	37.26	N
27	28	2-05	25°02.0'N 28°35.4'W	84	30	22.30	22.50	37.26	N
27	29	2-05	25°02.8'N 28°23.4'W	85	35	23.29	22.60	37.26	N
27	30	3-05	25°03.3'N 28°10.8'W	84	35	0.31	22.50	37.24	N
27	31	3-05	25°04.0'N 27°58.2'W	85	30	1.30	22.80	37.22	N
27	32	3-05	25°04.7'N 27°45.5'W	85	59	2.30	22.70	37.02	N
27	33	3-05	25°05.6'N 27°32.9'W	85	30	3.30	22.80	37.17	N
27	34	3-05	25°06.3'N 27°20.1'W	85	30	4.30	22.10	37.19	N-D
28	1	3-05	25°15.8'N 26°10.8'W	77	30	10.10	22.10	37.12	D
28	2	3-05	25°31.7'N 24°58.4'W	72	26	16.37	22.10	37.13	D

Table II

The ratio of *Distephanus* and *Dictyocha* with the sea surface temperatures of the samples.

Dictyocha		*Distephanus*	Temperature	Station
1	:	1.5	6.6°	10
1	:	6.7	6.7°	11
1	:	4.1	8.7°	8
1	:	3.4	8.7°	8
1	:	2.5	10.8°	9
1	:	3.9	10.9°	9
1.2	:	1	11.0°	13
3.3	:	1	11.3°	13
1.2	:	1	12.0°	13
11.3	:	1	12.7°	14
26.1	:	1	13.0°	14
14.0	:	1	13.2°	14
12.0	:	1	14.5°	15

Table III

The division of the area investigated according to the larger microplankton faunas and the hydrography.

Station:	Fauna type:	Water mass:	Influence of:
10	Subarctic cold water	Subarctic	
11	" " "	"	
12	Cold Temperate	Temperate	N. Atlantic Drift
13	" "	"	
14	" "	"	
15	Warm Temperate	"	
16	" "	"	N. Atlantic Drift
17	" "	"	Sargasso Gyre
18	North Sargasso Sea	"	" "
19	" "		" "
20	South Sargasso Sea		" "
21	" " "	N. Atlantic Central	" "
22	" " "	" " "	" "
23	" " "	" " "	" "
24	" " "	" " "	" "
25	" " "	" " "	Tropical influences
26	" " "	" " "	" "

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