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Luiza BIELECKA and Maria I. ŻMIJEWSKA

Institute of Oceanography
University of Gdańsk
Al. Piłsudskiego 46
81-378 Gdynia, POLAND

Chaetognatha of Drake Passage and Bransfield Strait (December 1983 – January 1984, BIOMASS – SIBEX)

ABSTRACT: Materials used in this work were collected during BIOMASS – SIBEX project in the Drake Passage and the Bransfield Strait (1983/1984) in three water layers: 0 – 100 m, 100 – 300 m and 300 – 500 m. Four species of Chaetognatha were found: *Eukrohnia hamata* and *Sagitta gazellae* in both water regions; *Sagitta planctonis* occurred mainly in the Drake Passage whereas *Sagitta marri* was noted in the Bransfield Strait and adjacent parts of the Bellingshausen and Scotia seas. Chaetognatha were most numerous in the Drake Passage and generally in the layer 100 – 300 m. Vertical distribution of Chaetognatha was clearly influenced hydrological conditions.

K e y w o r d s: Antarctica, plankton, Chaetognatha.

Introduction

Chaetognatha are widely distributed and almost totally planktonic group. In the open ocean they often occur in great numbers. Particular species are not tolerant to major changes of hydrological conditions and therefore they may serve as biological indicators of water masses (David 1965). According to Voronina (1984) in Antarctic waters Chaetognatha are important element of mesoplankton constituting 9.8% of its total biomass. In the Antarctic region only Copepoda have higher contribution in the mesoplankton biomass. Since in the large part of the Southern Ocean the share of mesoplankton is about 90% of total zooplankton biomass, the role of Chaetognatha must be recognized as a very important one. Chaetognatha strongly influence the populations of Copepoda and Euphausiacea, which are their basic food (Hopkins 1985).

The aim of the present work was to analyze the horizontal and vertical distribution of Chaetognatha in the Drake Passage, the Bransfield Strait and adjacent areas. Waters of this region are characterized by intensive dynamics expressed by many interesting hydrological phenomena that influence the distribution of zooplankton.

Material and methods

Planktonic material used in this work was collected during the scientific cruise of r/v "Profesor Siedlecki" from December 10, 1983 to January 8, 1984. This was a part of BIOMASS-SIBEX project. The material contained 97 samples from 47 stations (Rakusa-Suszczewski and Lipski 1985).

Table I

The distribution of Chaetognatha in the 0–100 m layer (number of individuals per 1000 m³) at the stations situated in the Drake Passage and the Bransfield Strait (December 1983–January 1984)

Station	*E. hamata*	*S. gazellae*	*S. marri*	*S. planctonis*
56	26	—	—	—
59	53	—	—	—
61	26	26	—	13
63	442	52	—	—
65	104		—	—
68	—	—	—	—
71	—	—	—	—
74	—	—	—	—
78	—	—	—	—
80	—	—	—	—
82	—	—	—	—
84	—	26	—	—
87	26	—	—	—
89	26	26	—	—
92	78	26	—	—
105	494	26	—	—
112	26	—	—	—
114*	46	15	—	—
117	—	26	—	—
120	—	—	—	—
128	—	—	—	—
130	26	—	—	—
135**	18	—	—	—
141	—	—	—	—
143	26	—	—	—
146	208	—	26	—
153	—	—	—	—
157	104	—	—	—
160	—	—	—	—
163	26	—	—	—
166	316	—	—	—
174	53	316	26	—
177	237	—	—	—
211	—	—	—	—
214	—	—	—	—
218	—	—	—	—

* — 0–170 m layer
** — 0–145 m layer

Table II

The distribution of Chaetognatha in the 100–300 m layer (number of individuals per 1000 m³) at the stations situated in the Drake Passage and the Bransfield Strait (December 1983–January 1984)

Station	*E. hamata*	*S. gazellae*	*S. marri*	*S. planctonis*
4	81	—	10	—
56	434	26	—	—
59	250	26	—	—
61	714	52	—	13
63	1351	52	—	104
65	39	—	—	—
68	—	—	—	—
71	130	26	—	—
74	520	—	—	—
76	507	13	—	—
78	753	13	—	13
80	429	65	—	—
82	974	39	—	—
84	416	26	—	—
87	—	—	—	—
89	78	13	39	—
92*	234	—	9	—
94	520	—	13	—
97	337	—	29	—
100	935	65	—	13
103	206	20	—	9
105	342	—	—	—
120	—	—	—	—
122	208	13	—	—
128	65	—	—	—
130	13	13	13	—
132	429	—	—	—
141	169	—	—	—
143	195	13	—	—
146	416	13	39	—
163	124	—	—	—
166	404	—	18	—
169	38	—	—	—
174	447	26	26	—
177	197	13	13	—
209	78	13	—	13
211	250	19	—	10
214	169	—	—	26
218	156	—	—	—

* — 0–300 m layer

These samples were caught with a Nansen planktonic net of the diameter of 70 cm and mesh size of 260 μm. In principle the material was collected with vertical hauls from three standard layers: 0–100 m, 100–300 m, 300–500 m; in some few cases the whole 0–300 m or 300–500 m water column was sampled.

Table III

The distribution of Chaetognatha in the 300–500 layer (number of individuals per 1000 m³) at the stations situated in the Drake Passage and the Bransfield Strait (December 1983–January 1984)

Station	*E. hamata*	*S. gazellae*	*S. marri*	*S. planctonis*
53*	116	—	—	—
56*	132	5	21	—
59	1013	53	—	—
61	312	39	—	39
63*	592	31	—	31
65*	—	—	—	—
74*	171	21	—	—
76	520	52	—	130
78	558	52	—	13
80	1065	91	—	91
82	1338	156	—	78
84	118	—	24	—
87	481	—	91	—
89	390	26	104	—
94	143	13	39	—
100	455	13	—	26
120	91	—	—	—
132	1987	39	—	—
141	766	13	26	—
143	273	—	26	—
209	312	13	—	13
214	390	13	—	39

* — 0–500 m layer

At the neritic near-shore stations one vertical haul from the bottom to the surface was carried out.

The material was immediately preserved in 4% formaline solution. Chaetognatha were selected from the rest of zooplankton in the laboratory. Determination of Chaetognatha was based on the papers by Tokioka (1965), Alvarino (1967), Dinofrio (1973) and Boltovskoy (1981). The number of specimens was calculated for 1000 m³ (Tabs. I–III).

Results and discussion

According to David (1965), 15 Chaetognatha species were ever recorded in the Southern Ocean. They belonged to three groups: endemic Antarctic species, species of wider distribution with southern limits entering Antarctic region and so called "exotic" species, which are unable to maintain their population in the Southern Ocean.

The biological analysis of our planktonic material of the austral summer 1983/1984, showed a low species diversity of Chaetognatha. In the region under

study four species were encountered: *Eukrohnia hamata* Möbius, 1875, *Sagitta gazellae* Ritter–Zahony, 1909, *Sagitta marri* David, 1956 and *Sagitta planctonis* Steinhaus, 1826. Among them two were endemic to Antarctica: *S. gazellae* and *S. marri* (David 1965). The other two species: *E. hamata* and *S. planctonis*, are wider distributed ones that can maintain their populations in cold Antarctic waters (David 1965).

The species poverty of Chaetognatha in this region can be explained by the small geographical extension of the area (59°59,8'S–64°30,2'S; 66°00,6'W–54°13,3'W), and the sampling of only upper 500 m layer.

The basic features of distribution of Chaetognatha in Antarctic waters are zonal species occurrence, their concentration in particular layers and the temperature as a factor keeping species within some depth range. These features were noticed by Alvarino (1965), David (1965), and Boysen-Ennen and Piatkowski (1988).

In the investigated material Chaetognatha occurred at all stations (Fig. 1, Tabs. I–III), except stations 68, 153 and 160 (at the last two stations only the 0–100 m layer was sampled). The highest abundance of Chaetognatha was found in the Drake Passage. The hydrological situation in this area was more stable than in the Bransfield Strait (Grelowski and Tokarczyk 1985).

A clearly dominant species of Chaetognatha in open and shelf waters of the whole studied area was *Eukrohnia hamata*. This species constituted about 90% of all Chaetognatha, and at 9 stations, located in the eastern and central part of the study area, it was the only Chaetognatha species recorded (Fig. 1).

E. hamata reached its maximum density (1987 ind. per 1000 m^3) at station 132, in the central part of the Bransfield Strait at the depth of 300–500 m. This station is situated in the area where two water masses meet (quasi-front in the reversible meander near Deception Island and Tower Island — Grelowski, unpubl.). This specific hydrological situation might be the reason of this high density of *E. hamata*.

In general, the abundance of *E. hamata* increased northwards. This phenomenon is connected with *E. hamata* maximal abundance in the Antarctic Convergence region recorded already by Hardy and Gunther (1935). High densities of *E. hamata* were found in the area of the Bellingshausen Sea waters influence, i.e. in western parts of the Bransfield Strait and in the Drake Passage, where the salinity of water is slightly lower and the temperature is higher (Grelowski and Tokarczyk 1985). This is in good agreement with the observations by Mackintosh (1934), who has found that *E. hamata* was abundant in the Bellingshausen Sea.

Eukrohnia hamata is a cosmopolitan species with relatively wide hydrological tolerance and is commonly regarded to be the most abundant Chaetognatha species of Antarctic and subantarctic regions. The dominance of this species among Antarctic Chaetognatha was noted by David (1965), Boltovskoy

(1981), Jażdżewski, Kittel and Łotocki (1982), Hopkins (1985) and Witek et al. (1985). *E. hamata* occurred in the whole vertical transect studied with the tendency to concentrate in the 500–100 m layer (Tabs. I–III). The highest densities of this species, over 1000 ind. per 1000 m^3 in the layer 500–300 m, was found at the stations situated mainly at the periphery of the study area (stations 59, 80, 82, 132) and at station 63 (1351 ind. per 1000 m^3), in the layer 300–100 m (Fig. 1). This vertical distribution corresponds well to the results made by David (1965); this author observed that *E. hamata* in migrates in summer towards the surface and concentrates at depths around 500 m. David (1965) recorded in the summer season a similar vertical distribution for three different longitudes in the Southern Ocean, i.e. 80°W, 0°, 90°E.

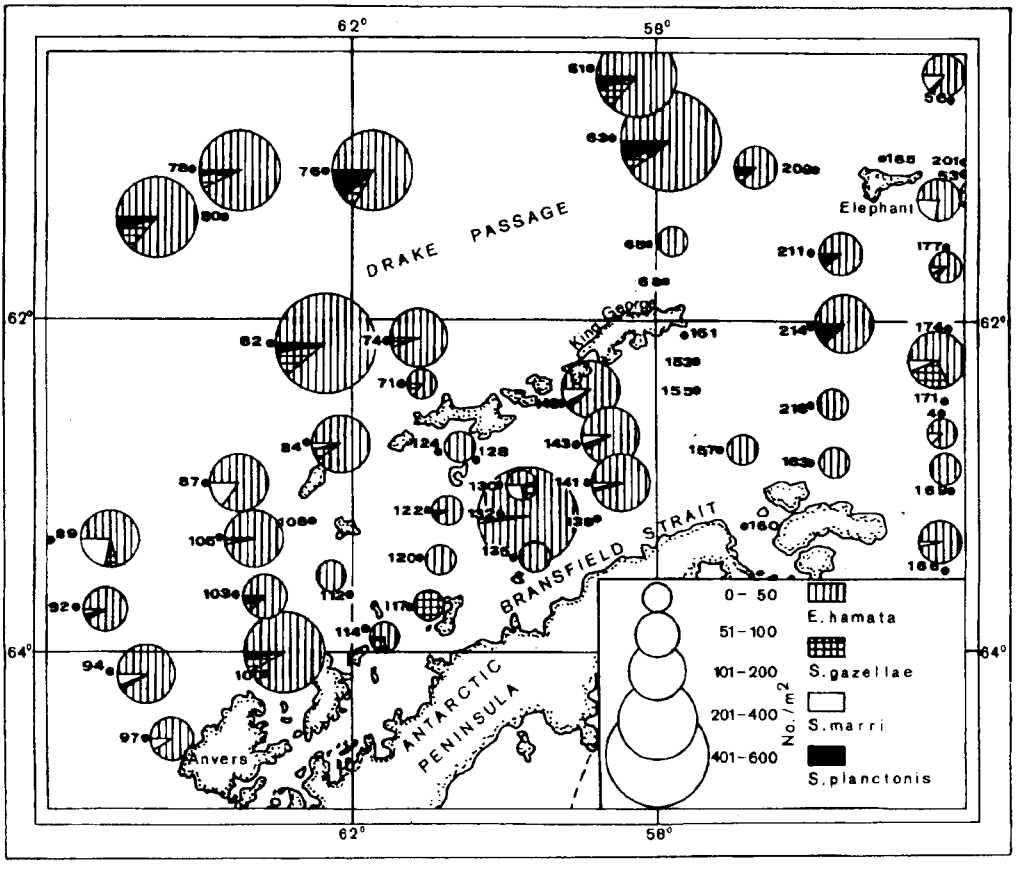

Fig. 1. The quantitative distribution of Chaetognatha (ind. /1 m^2) in the Drake Passage and the Bransfield Strait (December–January 1983/84)

The second species, according to the percentage share (about 6%) in the study area was *Sagitta gazellae*. In the investigated material *S. gazellae* occurred mainly in the Drake Passage waters with the maximum density of 316 ind. per 1000 m^3 at station 174 (100–0 m layer; Tab. I). Clearly less abundant was *S. gazellae* in the Bransfield Strait, where the influence of the Weddell Sea waters was higher. The occurrence of *S. gazellae* is limited to the south by the Antarctic neritic zone; this species prefers open waters (David 1965, Dinofrio 1973).

In general, in the Southern Ocean *S. gazellae* occurs with *E. hamata* (Hagen 1985), but *S. gazellae* is less tolerant to the changes in the physico-chemical environmental conditions (Hutchinson 1953). According to David (1965), south of 50°S, *S. gazellae* is an epipelagic species concentrating in the layer 50–250 m; rarely and scarcely it was found down to the depth of 1000 m. Hopkins (1985) also observed that *S. gazellae* inhabits Antarctic waters mainly down to 200 m.

The third representative of Chaetognatha in the studied area was *Sagitta marri* (about 2% of all Chaetognatha). It occurred mainly in the Bransfield Strait and was almost absent to the Drake Passage waters (Fig. 1). Maximal density was found in western part of the investigated region at stations 89 (104 ind. per 1000 m^3) and 87 (91 ind. per 1000 m^3) in the 500–300 m layer (Tab. III).

In the investigated region *S. marri* occurred in deeper layers with comparatively higher densities at depths below 300 m (Fig. 2). Especially clearly it was observed at stations 84, 87, 89 and 94 in western part of the region (Tabs. I–III). Only in two stations — st. 146 and st. 174 — it was more abundant in the layer 0–100 m. These depth preference of *S. marri* were noted also by David (1965) and Hopkins (1985).

S. marri is a meso- or batypelagic species, endemic to the Antarctic. Its main concentrations were observed south of the Antarctic Convergence (Alvarino 1967). According to Hutchinson (1953), *S. marri* is an indicator of the Antarctic coastal waters.

The patchiness of distribution of *S. marri* in the same area was noted by Witek et al. (1985). David (1965) has mentioned that *S. marri*, a species of low tolerance to the changes in hydrological conditions, is a good indicator of water masses. The lack of this species in those stations of the Bransfield Strait where water masses of Bellingshausen and Weddell seas are mixing (Grelowski and Tokarczyk 1985) confirms the preferences of *S. marri*.

Sagitta planctonis was found throughout the area in abundances similar to *S. marri*. Its highest density was noted at stations 76 and 63 (Tabs. II, III). In the investigated area *S. planctonis* was almost absent to the 100–0 m layer. Its relatively highest density was noted in layers 300–100 m and 500–300 m (stations 63, 76, 80, 82) in the northern part of the study area (Tabs. II–III, Fig. 2). According to Alvarino (1964) the highest densities of *S. planctonis* in Antarctic region can be found in the layer 600–150 m. This author was of the

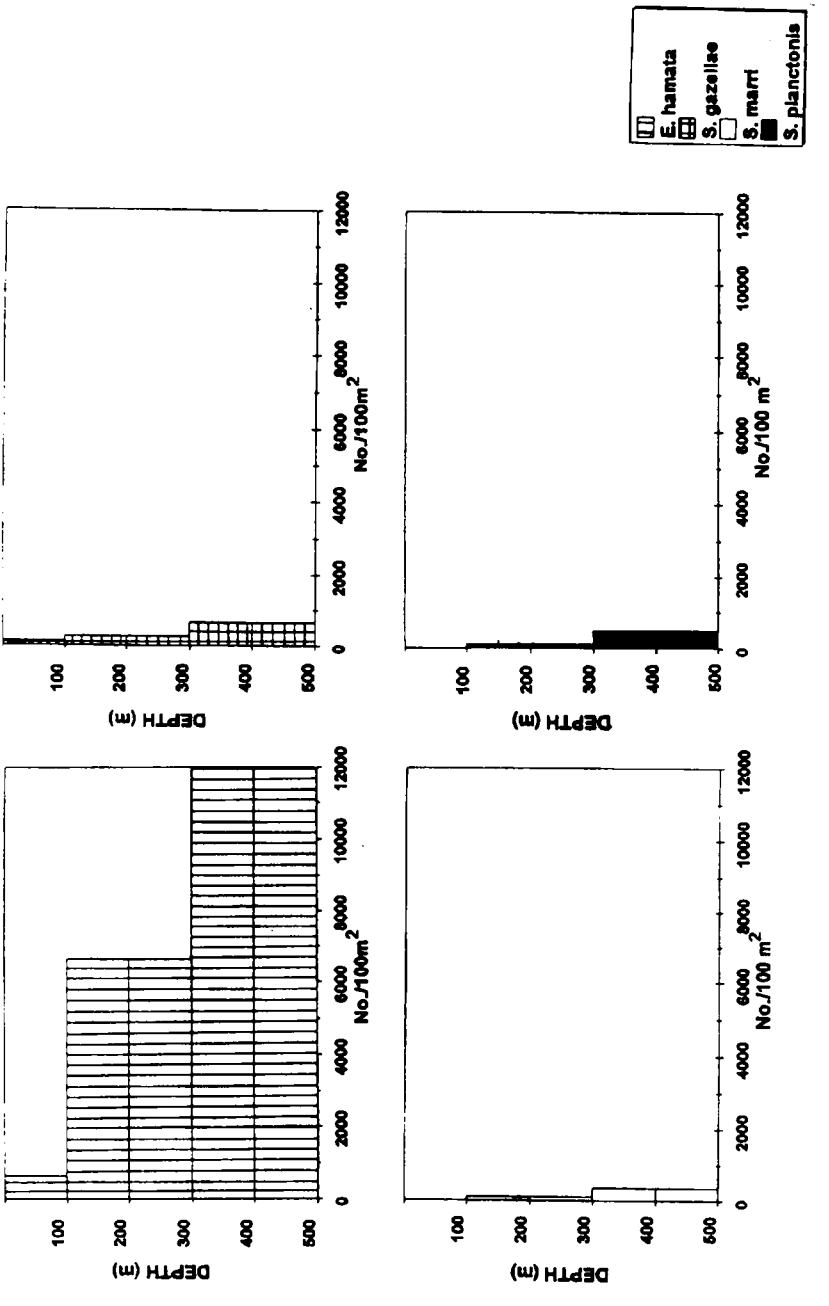

Fig. 2. The average number of particular Chaetognatha species in water column (ind./100 m²)

opinion that *S. planctonis* is characteristic rather to the subantarctic open waters. On the other hand, Boltovskoy (1975) suggested that *S. planctonis* is not only a mesoplanktonic species but can also occur in the epipelagic layer at lower latitudes.

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Streszczenie

Materiały Chaetognatha zebrane przez polską wyprawę w ramach programu BIOMASS-SIBEX obejmowały 97 prób z 47 stacji rozmieszczonych głównie w Cieśninie Drake'a i Cieśninie Bransfielda. Próby były pobierane pionowymi zaciągami siatki Nansena w warstwach wody 0–100, 100–300 i 300–500 m. Oznaczono 4 gatunki Chaetognatha: *Eukrohnia hamata, Sagitta gazellae, S. marri* i *S. planctonis*. Zdecydowanym dominantem (90% materiału) był *E. hamata*. Praca przedstawia horyzontalne (Rys. 1) oraz pionowe (Rys. 2) występowanie Chaetognatha na badanym obszarze, zaś dane ilościowe dla poszczególnych stacji zestawiono w tabelach I–III.