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From the Biologische Anstalt Helgoland and Zoologisches Institut und Zoologisches Museum der Universität, Hamburg

**Results of the research cruises of FRV "Walther Herwig" to South America. LV. Chaetognatha from the Patagonian Shelf in February 1971**

By HELGA KAPP  
With 5 figures

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**Kurzfassung**

**Ergebnisse der Forschungsreisen des FFS „Walther Herwig“ nach Südamerika. LV. Die Chaetognathen vom Patagonienschelf im Februar 1971**

Die Chaetognathen vom Patagonienschelf vom Februar 1971 wurden quantitativ bestimmt. *Eukrohnia hamata* und *Sagitta gazellae* wurden auf dem südlichen Patagonienschelf und im Falklandstrom gefunden. Von beiden Arten waren nur junge Tiere vorhanden. Auf der Burdwoodbank wurde ausschließlich *S. gazellae* gefangen. *S. tasmanica* war in vielen Proben vom gesamten südlichen Teil des Schelfes und aus dem Falklandstrom enthalten. Sie erschien in allen Reifestadien. Auch *S. friderici* war in allen Reifestadien vorhanden. Diese wurde in den Küstengewässern südlich der Halbinsel Valdés festgestellt. Nur 3 Proben aus der Nähe Feuerlands enthielten junge Exemplare von *S. maxima*. Diskutiert werden die Verbreitung und Taxonomie der genannten Arten mit Hinblick auf die hydrographischen Verhältnisse, die Ursache für das Fehlen einiger von anderen Autoren festgestellter Arten sowie die Abwesenheit adulter *S. gazellae* und *E. hamata*.

**Abstract**

Chaetognaths from the Patagonian Shelf from February 1971 were quantitatively identified. *Eukrohnia hamata* and *Sagitta gazellae* were found in the southern part of the Patagonian Shelf and in the Falkland Current. Only young specimens of them occurred. On the Burdwood Bank only *S. gazellae* was present. *S. tasmanica* was contained in many samples spread over the entire southern part of the Patagonian Shelf, and from the Falkland Current. *S. tasmanica* was found in all stages of maturity. *S. friderici* was present in coastal waters south of the Valdés peninsula and in all stages of development. Only 3 samples near Tierra del Fuego contained young specimens of *S. maxima*. Discussed are the questions of distribution and taxonomy of the species mentioned above, their relation to hydrographic conditions, and the reasons for the absence of certain other species from the samples that were recorded by other authors and the missing of adults of *S. gazellae* and *E. hamata*.

**Introduction**

Chaetognaths appear with relatively few species in the South Atlantic, but at times in large numbers of specimens. The same is true of the Patagonian Shelf, a region at the

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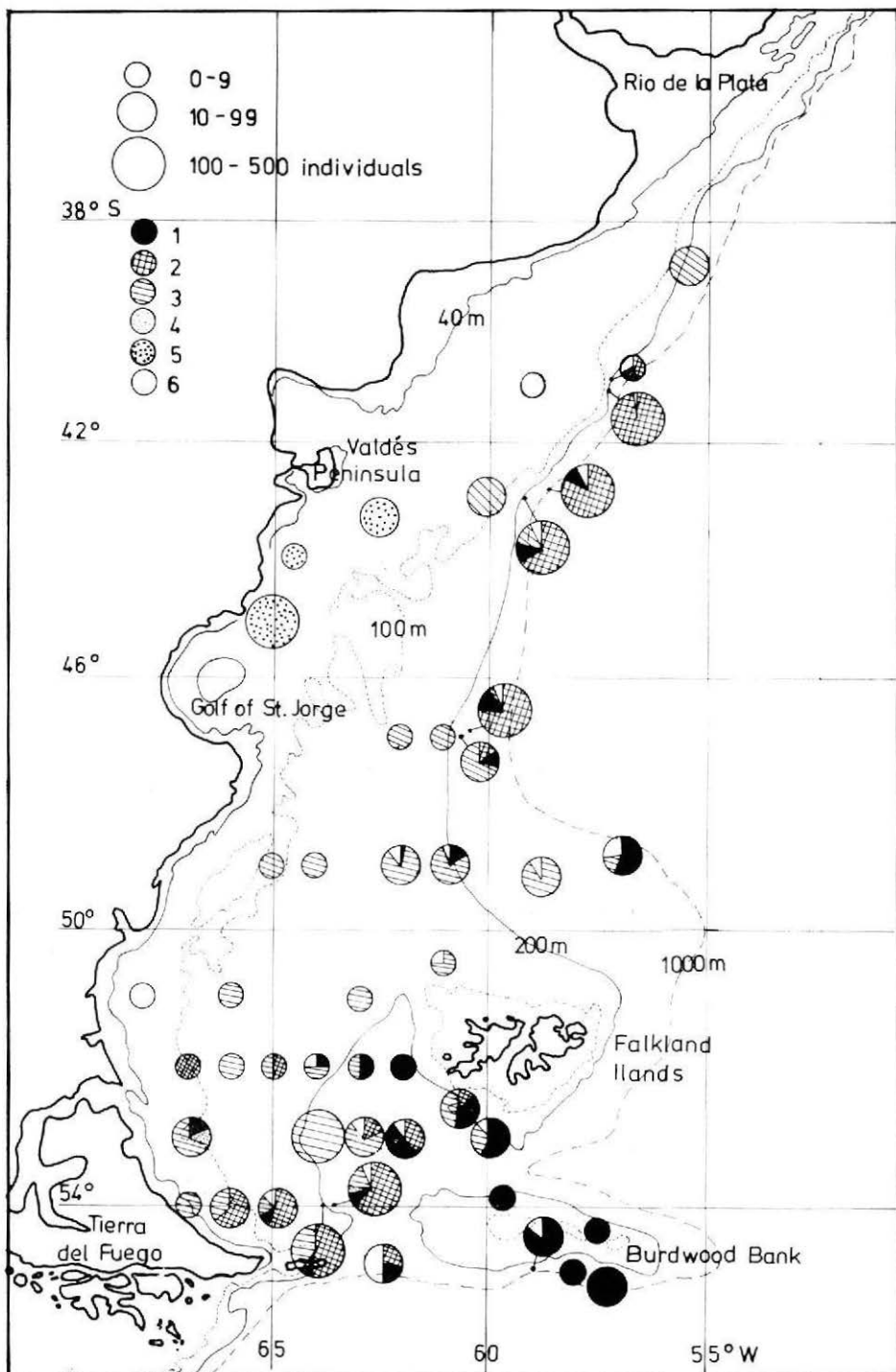


Fig. 1: Chaetognatha from plankton samples from Patagonian Shelf from February 1971.  
 1 *Sagitta gazellae*. — 2 *Eukrohnia hamata*. — 3 *Sagitta tasmanica*. — 4 *Sagitta maxima*. —  
 5 *Sagitta friderici*. — 6 not identifiable.

margin of the South Atlantic. Owing to the particular topography and hydrological conditions of this region a distinct distribution of chaetognaths is supposed.

During the fishery expedition, cruise 36, of FRV "Walther Herwig" in the southern summer 1970/71 plankton samples were collected over the Patagonian Shelf to complement research in fishery biology. The present investigation was undertaken to record the population of Chaetognaths on the Patagonian Shelf including remarks on their geographical distribution and taxonomy.

### Material and Methods

During cruise 36 of "Walther Herwig" plankton samples were taken on the Patagonian Shelf from 2—26 February 1971; 47 of them contained chaetognaths. The area under investigation reached from Tierra del Fuego to Mar del Plata, i. e. from about 55°S to about 37°S and includes the Falkland Islands and Burdwood Bank (see Fig. 1). The southern part of the Patagonian Shelf is well covered by the net of stations while in the northern part, as at least as far the Chaetognaths are concerned, coverage is incomplete.

The plankton samples were taken with a Helgoländer larvae net, towed vertically at a speed of about 0.75 m/sec, from a depth of 50 m to the surface. At two stations the depth was less than 50 m, but there the samples contained no chaetognaths. The diameter of the mouth of the net was 1.10 m; thus, assuming a 100 % filtration rate during ascent of the net, the volume of water filtered amounts to 47.5 m<sup>3</sup>. The samples were fixed and preserved in a 2—3 % formaldehyde solution in sea water buffered with calcium carbonate.

Most of the samples were sorted in the Institut für Seefischerei der Bundesforschungsanstalt für Fischerei in Hamburg into major taxonomic groups. The chaetognaths from the remaining samples were picked out in the Zoologisches Institut der Universität Hamburg. The sorting was done very carefully (see BÜCKMANN, 1974) so that one can presuppose that all Chaetognaths of the expedition were available for this investigation.

The chaetognaths are very well preserved because of the careful method of collecting of the Helgoländer larvae net. All animals, except the very young and very few damaged specimens, were identified either under a stereo microscope (magnification 10—40x) or in addition, under a compound microscope (magnification 100—400x) when particular characteristics required it.

### Hydrographic Conditions

Fig. 5 shows the surface temperatures of the area investigated. It was drawn by LENZ (unpubl.) from the temperature measurements taken on legs 1 and 2 of "Walther Herwig" cruise 36. Although it covers the period of two months, January and February 1971, it is thought to serve as a basis for the conditions that existed during the time of sampling.

On the northern Patagonian Shelf the isotherms paralleling the edge of the shelf clearly indicate the Falkland Current, which, because of its vertical extension, follows the edge of the shelf. To the east the Falkland Current is bounded, as far as to the region of the subtropical convergence, by the warm Brazil Current partly forming clearly marked eddies (satellite foto LENZ, pers. comm.). On the northern part of the shelf a temperature discontinuity is formed in the southern summer (STEHMANN and LENZ, 1972). Hydrographical conditions on the southern Patagonian Shelf are determined by low water

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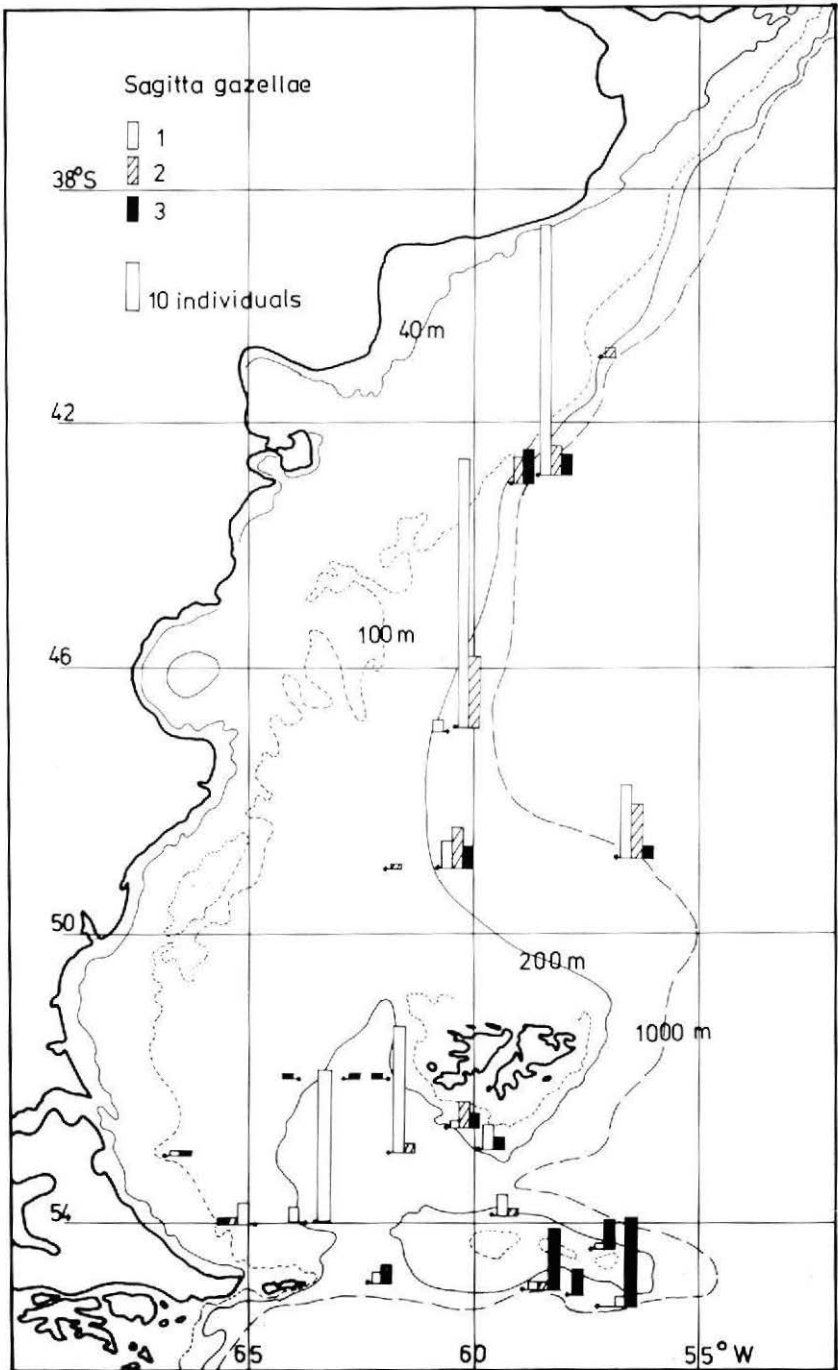
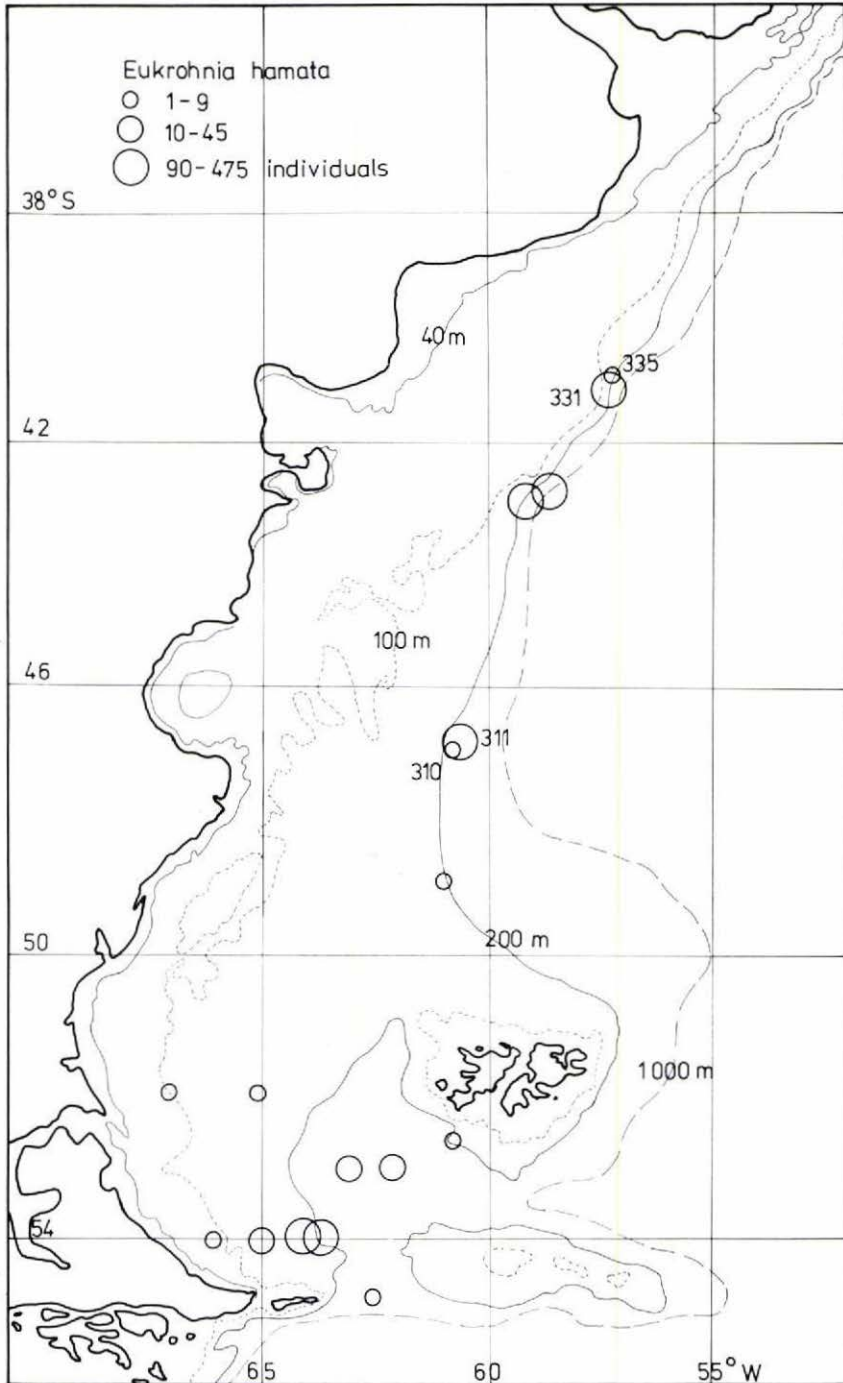


Fig. 2: Frequency and length of *Sagitta gazellae*.  
 1 length up to 20 mm. — 2 length 21–40 mm. — 3 length 41–60 mm.

Fig. 3: Frequency of *Eukrohnia hamata*.

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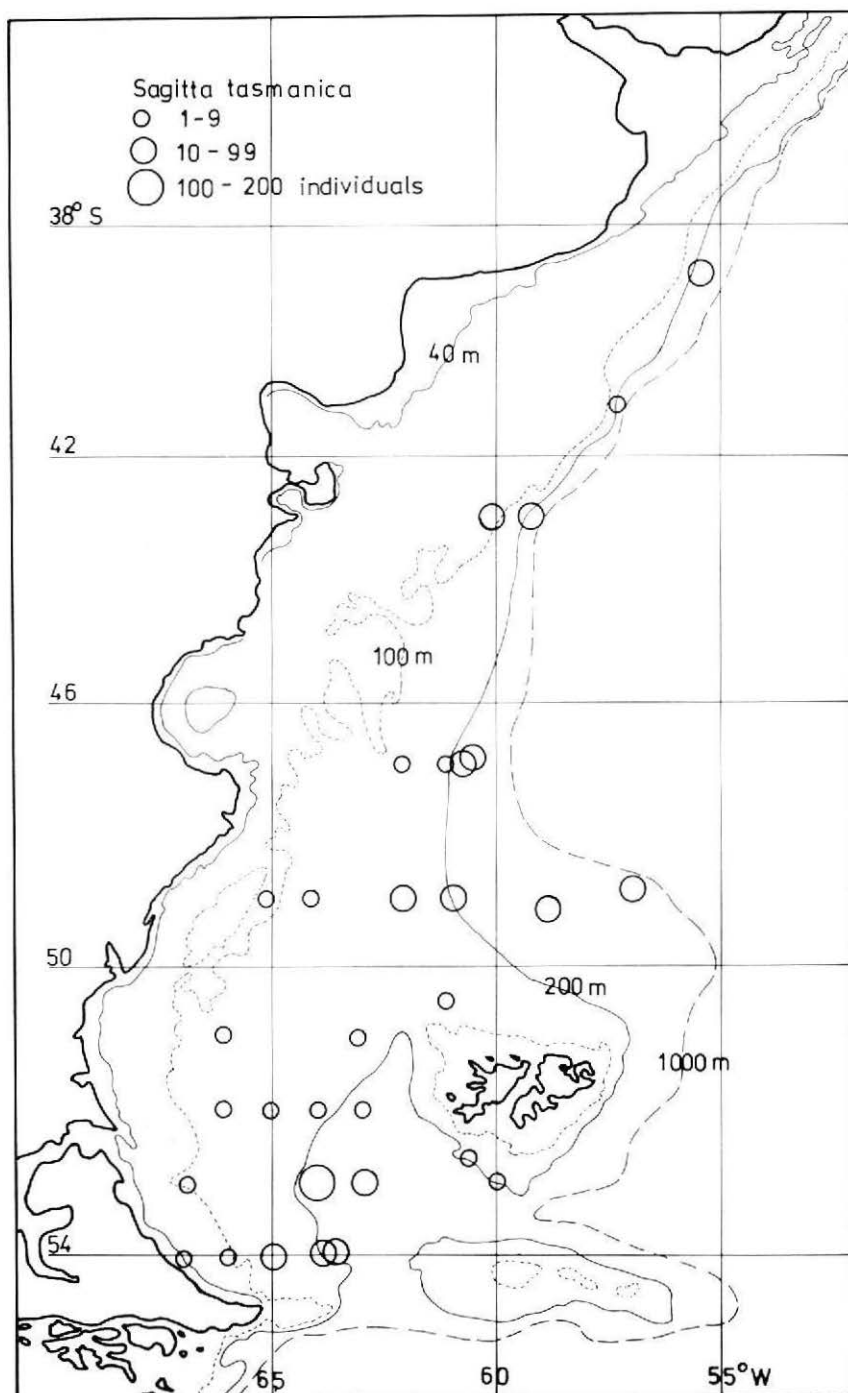


Fig. 4: Frequency of *Sagitta tasmanica*.

temperatures throughout the year. The currents are variable and instable. In essence, originating from the Cape Hoorn Current, a large slow "whirl" forms between Falkland Islands and Tierra del Fuego and, resulting from the currents that pass east and west of the Falkland Islands in northerly direction the Falkland Current develops (BOLTOVSKOY, E., 1970; LENZ, pers. comm.).

## Results

### *Eukrohnia hamata* (Möbius)

*Eukrohnia hamata* (see Figs. 1 and 3) is present in samples of the southern Patagonian Shelf, in the area between Falkland Islands and Tierra del Fuego. The numbers of specimens range from single ones to about 250 per haul. In the northern section of the area under investigation it occurs in samples that were taken along the edge of the shelf, thus in the northward flowing Falkland Current. Here it is found in few specimens or in numbers of 100 to 500 per samples. The species is absent from the Burdwood Bank.

It is remarkable that all *E. hamata* caught during this cruise are juveniles or specimens only few mm longer than juveniles. As juveniles are considered all *E. hamata* that carry plumed hooks, that means all specimens up to a length of 11–12 mm. The last juvenile hook with worn plumes is often observed in animals of this length.

### *Sagitta gazellae* Ritter-Zahony

24 samples contain *S. gazellae* (Figs. 1 and 2). These samples were taken on the Burdwood Bank, in the southern part of the Patagonian Shelf, and in the northern part of the Falkland Current following the edge of the shelf. The northernmost station at which *S. gazellae* occurred is situated about 40 °S (Figs. 1 and 2). The number of specimens per haul was between a few and about 100 animals.

The length of most *S. gazellae* caught during this cruise is less than 20 mm. Sometimes *S. gazellae* attracted attention in the samples because of its large size; however, these animals were not mature. The maximum length (without tailfin) was 60 mm. The beginning of lengthening of female gonads was observed when the animals had reached about 50 mm in length. It is noteworthy that large *S. gazellae* are most frequent on the Burdwood Bank.

### *Sagitta maxima* (Conant)

Few juvenile specimens of *S. maxima* were found in 3 samples from the region east of Tierra del Fuego (Fig. 1). They are clearly distinguished from *S. gazellae* and *S. lyra*: the anterior fins of *S. maxima* begin at the middle of the ventral ganglion (in *S. gazellae* considerably below the ventral ganglion, in *S. lyra* a little below it); the tail is relatively long, constituting 20–25 % of the body length (in *S. gazellae* 10–15 %, in *S. lyra* 15–20 %); the ventral nerve cords come together at the ventral ganglion, not below the head as in *S. gazellae* and *S. lyra*.

### *Sagitta tasmanica* Thomson

The most widely spread species on the Patagonian Shelf is *S. tasmanica* (Figs. 1 and 4). It is contained in 31 samples with numbers of specimens from one to 175 and is present in all stages of development. It is absent on the Burdwood Bank and in all samples close to shore except on the transect along 54 °S where it is found near the coast. In the

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northern part of the area under investigation *S. tasmanica* is found in the region of the Falkland Current.

#### *Sagitta friderici* Ritter Zahony

*Sagitta friderici* (Fig. 1) was caught in only 3 hauls near the coast south of Valdés peninsula. All other species of Chaetognaths were absent in these three samples. *S. friderici* was present in all stages of maturity and partly in great numbers.

### Discussion

A large area was covered while zooplankton samples were being taken from almost the whole Patagonian Shelf during cruise 36 of "Walther Herwig" in the southern summer of 1970/71. However, some questions still remained unanswered because of restriction of sampling to the area of the shelf proper, of gaps in the array of stations, especially in the northern part of the region investigated, of the limitation to the upper 50 m of water depth; answers to these questions might have contributed to a better understanding of the results found.

It is remarkable that only young specimens of *E. hamata* and *S. gazellae* were caught. According to DAVID (1958) *S. gazellae* is considered one of the species that descend into deeper water to lay their eggs. He found very young stages of *S. gazellae* only just above 250 m. Fully matured *E. hamata* he ascertained in water deeper than 750 m, and spent *E. hamata* in the depth as well as at the surface. It is thus plausible that the adult *E. hamata* and *S. gazellae* are staying in the south or south west respectively, of the region investigated rather than below the sampled depth of 50 m. However, the data from the present collections can neither support nor disprove this supposition.

*E. hamata*, a cosmopolitan species, is recorded to be present in all depths in cold seas of the Northern Hemisphere as well as of the Southern Hemisphere. In tropical and subtropical water it stays in the cold water of depths deeper than 800 m (THIEL, 1938; DAVID, 1958; ALVARINO, 1969). In the present collection *E. hamata* is absent in the sample from the northernmost station at about 39°S (Fig. 1). BÜCKMANN (1974) found both warm water species and cold water species of Appendicularia in samples of stations between 38° and 39°S close together. Possibly the cold Falkland Current submerges already here below the warmer surface water (Fig. 5) (BOLTOVSKOY, E., 1970). In August 1970 and 1971 BOLTOVSKOY, D. found *E. hamata* still between 37° and 38°S that means in the southern winter this boundary is shifted to the north as could be expected. Between 35° and 36°S, i. e. in front of the Rio de la Plata estuary, the typical chaetognath species of tropical and subtropical water appear in BOLTOVSKOY'S samples. BÜCKMANN ascertained the same for Appendicularia and RAMIREZ (1971) for planctonic Copepoda, thus a faunal boundary caused by hydrographical conditions is situated in the region of the Rio de la Plata estuary. Where exact this boundary was situated in the southern summer of 1971 is not ascertainable as sampling did not extend far enough to the north.

*S. gazellae*, too, is absent in the northernmost sample. It is reported to be a species of subantarctic-antarctic waters and its limit of distribution is found in the region of the subtropical convergence (BOLLMANN, 1934; DAVID, 1958; ALVARINO, 1969). It can be supposed that this species has reached its northernmost appearance in the cold Falkland Current at about 40°S.

The range of distribution of *S. tasmanica* extends beyond the area investigated here in the north as well as in the south (ALVARINO, 1969; PIERROT-BULTS, 1976). It seems to be,

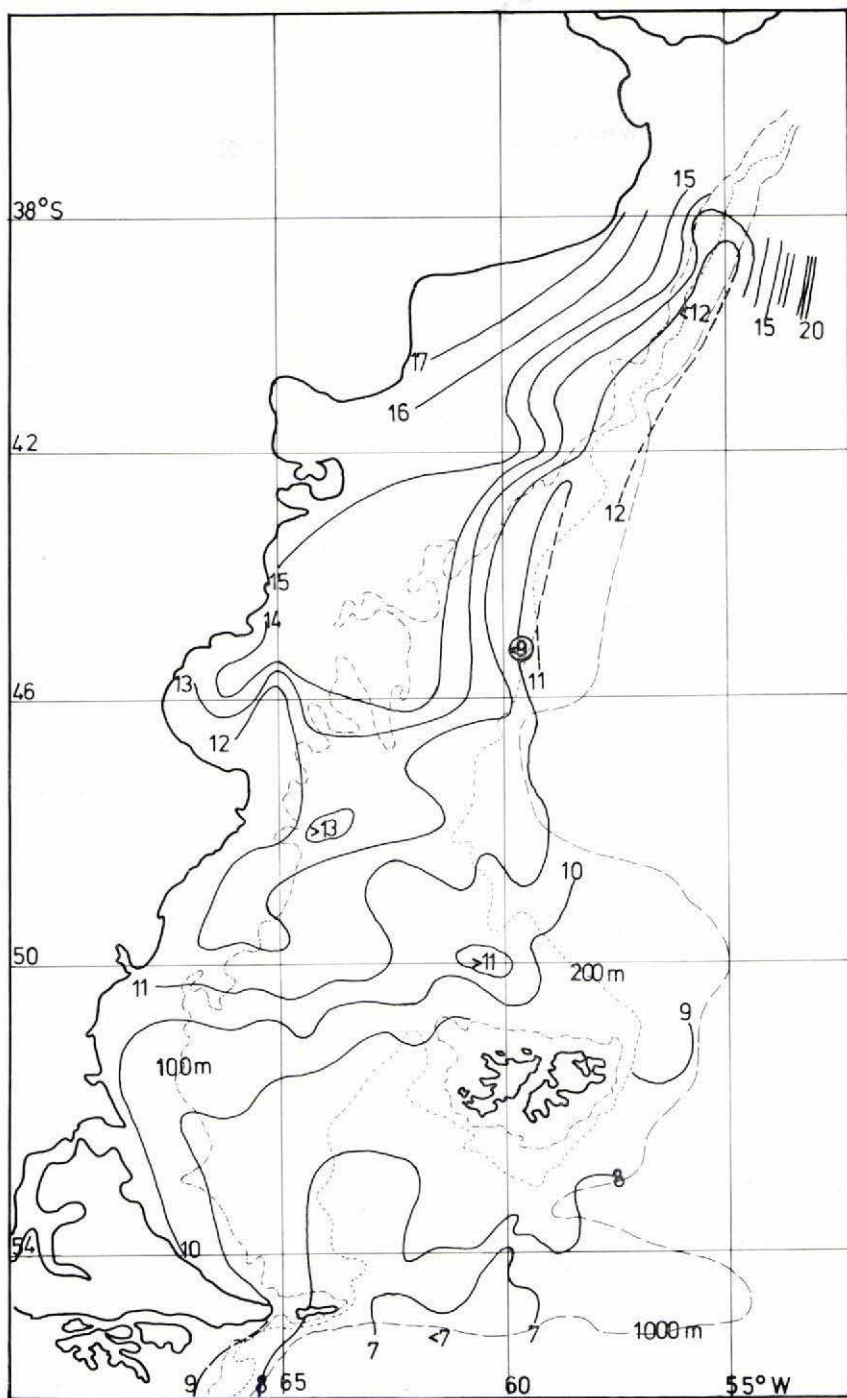


Fig. 5: Isotherms of the surface temperatures from January and February 1971 drawn by W. LENZ.

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together with *S. friderici* from coastal waters, the typical species on the Patagonian Shelf, although it is not always dominant. However, it is present in two thirds of the samples in which chaetognaths were found, its occurrence is spread over the entire area and it appears in all stages of development.

*S. friderici* is a typical form of coastal waters (CAVALIERI, 1963; da COSTA, 1970). The boundary of its occurrence in the south can be ascertained only approximately, as there were no samples taken in the Gulf of St. Jorge. In plankton hauls south of 49°S it is no longer found (Fig. 1).

Some species of chaetognaths other authors reported from the Patagonian Shelf (ALVARINO, 1969; БОЛТОВСКОУ, D., 1974, for example) were not found. The material under discussion did not allow to say whether they were absent on the Patagonian Shelf during this cruise or whether they stayed beneath the depth of 50 m. The species are: the mesopelagic *S. decipiens* (up to 40°S). *S. planctonis* and *E. fowleri*, which are found below 100 m or in even greater depth, the meso-bathypelagic species *E. bathypelagica* and the bathypelagic species, *E. bathyantartica*. Whether *S. tenuis*, a species of the surface, was present near the coast up to about 38°S, as ALVARINO reported (1969), could not be investigated as samples of this area are lacking. PIERROT-BULTS (1974, 1976) reported the presence of the surface species *S. serratodentata* (subspecies *serratodentata*) up to 40°S. However, as *S. serratodentata* is a tropical-subtropical species, it is probable that its range extends southward only as far as up to the estuary of the Rio de la Plata river during the time of this cruise and was therefore not collected.

Scattered tropical-subtropical species are found in the cold Falkland Current, for example БОЛТОВСКОУ, D. (1974) reported *S. hexaptera* and *S. serratodentata* between 42°S and 43°S. As explanation for their appearance is given — without mentioning possible misidentification that cannot be excluded entirely concerning chaetognaths — the formation of eddies at the boundary of Falkland — and Brazil Current. These eddies can dissociate from one current system and exist as closed water bodies for some time in the other current (e. g. LENZ, 1974).

At stations 310 and 311 there is with 3 and 69 specimens, respectively, a great difference in the number of individuals of *S. gazellae* (Fig. 2). The same is true for *E. hamata* for the same stations 310 and 311 with 3 and 299 specimens, respectively, and for the stations 331 and 335 with 266 and 3 specimens, respectively, (Fig. 3). Because these quantitative differences occur repeatedly and in different species it may be assumed that the boundary of the Falkland Current was caught between these pairs of stations. The map of the surface temperatures (Fig. 5), however, shows that the samples do originate from the core, not from the edge of the Falkland Current. The high differences in numbers are probably attributable to patchiness.

There are areas between Tierra del Fuego and the Falkland Islands where *E. hamata* (Fig. 3) and *S. gazellae* (Fig. 2) are present in great quantities. If it is assumed that these young animals have been transported by the Cape Hoorn Current, there is the possibility, that a more permanent current exists in his area at his season or that there is a peculiar component of the Cape Hoorn — Falkland Currentsystem. Of course this supposition must be examined in the light of results of oceanographic analyses.

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Author's address:

Dr. Helga Kapp  
 Zoologisches Institut und Zoologisches Museum der Universität Hamburg  
 Martin-Luther-King-Platz 3  
 2000 Hamburg 13

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