

VERSLAGEN EN TECHNISCHE GEGEVENS

Instituut voor Taxonomische Zoölogie (Zoölogisch Museum)

Universiteit van Amsterdam

No. 4

Resultaten van het plankton onderzoek met behulp van  
pommonsters in het kader van het Cicar (Cooperative  
Investigations in the Caribbean  
and Adjacent Regions) project

W.J. Brugge

No. 5

Preliminary results on appendicularians from the Cicar  
(Cooperative Investigations in the Caribbean and  
Adjacent Regions) cruises 1970

R.F. de Ridder

20 augustus 1974

Preliminary results on Appendicularians from the Cicar (Cooperative  
Investigations in the Caribbean and Adjacent Regions)  
cruises 1970.

R.F. de Ridder

INTRODUCTION

The Cicar-project (Cooperative Investigations in the Caribbean and Adjacent Regions project) offered an opportunity to collect epiplanktonic animals in the Southern part of the Caribbean Sea and in water north of Guyana in the Atlantic, to study the precise distribution of some groups in the area.

All the Cicar plankton samples were taken in superficial waters, mostly at depths not exceeding 6 m, but at some stations at depths of 10, 13 or 18 m (c.f. Cicar First Interim Report ITZ, 1971).

The samples were preserved in 4% formaline.

The present study deals with Appendicularians (Tunicata, Cope-lata). A list of species will be given together with some observations on the infraspecific variation. Attempts are made to relate the species composition to the hydrographic conditions of the studied areas, viz. the waters around the Dutch Leeward Islands (Curaçao, Aruba and Bonaire) and the waters off the coast of Surinam (Dutch Guyana). This study neatly fills the gap left by studies of the Appendicularians of neighbouring areas, viz. the Venezuelan coast (Zoppi de Roa, 1971) and the Brazilian East coast (Björnberg & Forneris, 1955).

## MATERIAL AND METHODS

Before the present study started the Appendicularians were sorted out from the samples by Mr. M.J. Koperdraat and the material was roughly preexamined by Drs. R.W.M. van Soest. Looking at unstained specimens he was already able to establish a provisional list of species (c.f. Cicar First Interim Report, 1971). It was clear that Oikopleura (Haplopleura) longicauda Vogt, 1854 is undoubtedly the most abundant species. The specimens belonging to other species and doubtful specimens were selected, stained according to the method described below, and mounted on slides.

A great number of O. longicauda was also mounted, but not all. In total 183 slides originating from 38 different plankton stations were made, most of them containing 8 specimens.

The histological staining was executed by Mr. A.F. de Fluiter, who must be thanked for his patient work. It was important that the thin, taxonomically important tail was manipulated in such a way that it was stretched out flat on the glass of the slide.

The slides were examined with magnification 100 x or 400 x.

## STAINING

Formalin 4% preserved specimens were washed in distilled water for about two minutes, after which they were exposed for ten minutes to a stain of the following composition:

Distilled water :	100 cc
Alisarine Red-S.:	0.30 g
Na <sub>2</sub> SO <sub>4</sub> :	2.85 g
C <sub>2</sub> O <sub>2</sub> H <sub>4</sub> (96%) :	5 cc (to be mixed in the given order, after which it has to be left unused for about 2 days).

After staining the specimens are washed in tap-water for 5-10 minutes, depending on the size of the specimens. Afterwards they are dehydrated in a series of alcoholic solutions of increasing alcohol content. Fully dehydrated they are made transparent during

a period of about five minutes in a mixture of wintergreen oil and toluol. Finally the specimens are mounted in rhenohistol.

## RESULTS

### 1. List of species

The following species were identified.

#### Family Oikopleuridae

- 1 Oikopleura (Haplopleura) longicauda Vogt, 1854
- 2 Oikopleura fusiformis Fol, 1872
- 3 Oikopleura fusiformis cornutogastra Aida, 1907
- 4 Oikopleura dioica Fol, 1872
- 5 Oikopleura rufescens Fol, 1872
- 6 Stegosoma magnum Langerhans, 1880

#### Family Fritillariidae

- 7 Fritillaria pellucida Bisch, 1881
- 8 Fritillaria formica Fol, 1874
- 9 Fritillaria haplostoma Fol, 1872
- 10 Fritillaria borealis sargassi Lohmann, 1896
- 11 Appendicularia sicula

### 2. Brief descriptions of the species

- 1 Oikopleura (Haplopleura) longicauda Vogt, 1854 (Pl.1)

This species is the most abundant and it occurred at most stations. Many hundreds of specimens were collected.

It is known for many years that this species is strongly variable. Two easily distinguishable forms were frequently found. One has the compressed egg-shape of the normal trunk, the other has a more elongate snout-like extension in front of the trunk. The latter seems not due to any kind of artefact, and is less common in number.

The identifications were often difficult, due to the bad condition of a number of specimens. The absence of buccal glands, only present in half the number of Oikopleuridae-species, was very helpful. These buccal glands were always heavily stained, like the endostyl, and the place where these glands are found can always be traced back easily. They lie at either side of the endostyl.

Another marked feature of O. longicauda is the rigid nature of its tail, having broad plates of musculature, which are seldom very much damaged, often perfectly stretched out in the slide.

Some species have one or more subchordal cells in the tail. They are used as a diagnostic feature. O. longicauda has none. But the absence of subchordal cells is a feature of little value in doubtful specimens. In several cases these cells were lacking, where they were to be expected.

Very characteristic in O. longicauda is the shape of the stomach and the entrance of the oesophagus in it. Behind the entrance of the oesophagus there is an outgrowth (blindsac) of the stomach, lying directly against the oesophagus, in contrast with the situation in the species Oikopleura intermedia Lohmann, 1896, which resembles O. longicauda in many respects. This species was not found. All the parts of the digestive system were heavily stained, sometimes even too darkly.

Characteristic too for the species is the presence of two dermal, transparent outgrowths, that may partly enclose the trunk, often called the "hood". However, in their normal habitat, they are frequently damaged. In the slides the twisted rest of this structure was often recognizable (Lohmann, 1896). The absence of this structure is meaning less (Fenaux, 1967).

The bulk of the specimens showed gonads in an early stage of development, lying against the stomach at the posterior of the trunk. In these cases there remains very little to be seen of the structure of the stomach, for the gonads were heavily stained.

## 2 Oikopleura fusiformis Fol, 1872 (Pl.2 fig. A-D)

This species is the second most abundant. It resembles O. longicauda in many respects, but it has some well recognizable differences. The shape of the trunk is more elongate. It is not

egg-shaped. The ends are more pointed. At the dorsal side this is probably caused by the very large caecum ending in a point and lying free from the rest of the stomach. The muscle plates in the tail are generally somewhat narrower than in O. longicauda, though a large variability exists. These muscles are always well stained. O. fusiformis has the following features in common with O. longicauda:

- 1) Subchordal cells in the tail are lacking.
- 2) Buccal glands are lacking.
- 3) The development of the gonads is as described for O. longicauda.

When the gonads expand over the lateral trunk, it becomes difficult to trace the stomach. The gonads are strongly stained, particularly so in specimens collected at station 177. The specimens of this station (Pl.2, fig. D) are quite different from all the specimens caught elsewhere. The trunk in these specimens is larger and not very pointed, particularly not at the dorsal side. The tail was considerably shorter than in all the other specimens, not being longer than twice the length of the trunk.

The muscle plates are narrow. However, I am positive that these specimens, lacking both buccal glands and subchordal cells, belong to O. fusiformis. O. fusiformis is considered a species-group by some authors, and very different formae have been described in other geographic areas. Among the present material 44 of these aberrant specimens are found. They occur in very shallow water (17 m) very near the coast of Guyana. It seems possible that we are dealing here with a special neritic forma of O. fusiformis. The length of the tail of O. fusiformis is in more typical slender specimens very much subject of variation. The tail may be very long (till 6 or 7 x the length of the trunk).

3 Oikopleura (fusiformis f.) cornutogastra Aïda, 1907 (Pl.2 fig. E)

O. cornutogastra is in comparison to O. fusiformis rare in the present material. In area 1 (Aruba, Curacao, Bonaire) it occurred at only three stations. These are stations at which O. fusiformis occurred also in greater number, which is an indication of their specific status. In area 2 (the coast of Guyana)

no specimens are found.

O. cornutogastra is often considered a forma of O. fusiformis and it is obvious that many features are the same. In both the tail, and the musculature in it, are narrower than in O. longicauda. Both species or formae are devoid of buccal glands and subchordal cells. In fact there is only one clear difference to distinguish them, at least in the slides:

In O. fusiformis the dorsal line of the trunk runs horizontally or in a faint curve from one end of the trunk to the other. In O. cornutogastra this dorsal line is interrupted at the dorsal side by a decline. This decline is caused by the outgrowth of a caecum. Both species or formae are characterized by a very long caecum. In the case of O. fusiformis the growth of this caecum is backwards, thus a smooth dorsal line is always formed. In the case of O. cornutogastra the direction of the growth of the caecum is not only backwards but also dorsal.

In a few cases it was difficult to distinguish the two species or formae. Intermediate forms seem to exist. O. cornutogastra often makes a more compact impression.

#### 4 Oikopleura rufescens Fol, 1872 (Pl.3 fig. A,E)

O. rufescens is common, but it occurred nowhere in great numbers.

The shape of the trunk is like in O. longicauda compact, but O. rufescens can never be confused with O. longicauda owing to the presence of large roundish buccal glands. It seems, that the dimensions of these glands are variable. The features of these glands are important, because this may be a possibility to distinguish O. rufescens and the closely related O. dioica, the latter having buccal glands and subchordal cells.

In some specimens the tip of the tail was not completely stretched and in these cases it is impossible to establish the presence of subchordal cells. O. rufescens has one elongated subchordal cell. The stomach makes a roundish impression, a caecum is absent. The gonads always lie separated from the stomach. Especially in the dorsal part of the trunk this is seen as a crevice. The endostyl ends in a point dorsally.

5. Oikopleura dioica Fol, 1872 (Pl.3 fig. B)

O. dioica is less common than O. rufescens. The buccal glands are always small and roundish. The shape of the body is more elongate. The dorsal line runs more horizontally and drops forward in a sharp curve. The tail has two elongate subchordal cells. The stomach has a caecum, which is situated dorso-ventrally of the trunk. Generally the position of the caecum in other species is more dorsal. In this part of the body the first development of the gonad takes place (this species is the only oikopleurid that is not hermaphroditic). The rectum is situated more forward than in O. rufescens and the shape is also different.

6. Stegosoma magnum Langerhans, 1880 (Pl.3 fig. C,D)

Stegosoma magnum is common, but never abundant. The identification of the first specimens was very difficult. The pharynx and oesophagus of this species are rather extensive and in some specimens this part of the trunk was lost, in others it was heavily damaged and only the "oesophagus" was present, making the impression of an elephants trunk in the slides. This species turned out to be one of the easiest to identify, by means of what may be called specific artefacts in the tail. The tails lie almost never properly stretched out in the slides. They seem to lie in irregular waves and ripples in a very characteristic way. Besides, Stegosoma magnum attracts immediately attention by the dimensions of trunk and tail. One specimen had even a bodylength of 3 mm and a taillength of 13 mm.

The tail should contain a row of subchordal cells, but I have not been able to find them. Some authors say that these cells are often difficult to distinguish. The digestive tract is horse-shoe-shaped, and it has a large caecum in the middle. The oesophagus/pharynx is very long. Far anterior to the pharynx is the long and narrow endostyl, accompanied by two small rounded buccal glands. The general impression of the trunk is highly affected by the stage of development of the gonads. In their development they expand laterally over the digestive tract, resulting in a characteristic V-shape (in dorsal view). Often three layers comprise the testes. The outer wall of the pharynx was very seldom to be seen.

7 Fritillaria haplostoma Fol, 1872 (Pl.4)

Many fritillarians were very much damaged. They are more fragile than the Oikopleuridae. In the trunk the finer structure is often lost completely. In the identification of the specimens I was bound to deal with relatively few features. Nevertheless identification seemed possible in the majority of the specimens. Unfortunately an extensive description of the variability of complete specimens is hardly possible. The features in the tail are often the best to be examined. F. haplostoma has a long tail with narrow muscle plates. These muscles are always stained in the slides. At either side of these muscles the tail has broad transparent flaps, ending with round "shoulders" at the upper side; at the lower side the tail ends in a point.

In the literature I found that the presence of amphichordal cells is particularly subject to variation. The size, the number and the arrangement may differ very much. In a number of specimens belonging to F. haplostoma these cells seem to be lacking entirely, though I am not absolutely sure of this. For this reason I tried to group them under F. borealis forma typica. This forma has a narrow musculature as well (though that of F. haplostoma seems narrower), amphichordal cells are lacking and many features of the trunk (in all the specimens I had to deal with artefacts) resemble those of F. haplostoma. The part of the trunk in front of the stomach is in both species large. Both have the same type of endostyl and the same arrangement of the gonads, testis and ovary lying one behind the other. This possibility was rejected after all, primarily on morphological grounds: I was able to establish that the tail terminated in a point. In a lot of specimens this was difficult to see, but finally I found some in which the tails undoubtedly terminated in a point. Secondly because F. borealis forma typica is considered a typically cold-water dweller. So occurrence of F. borealis forma typica is not very likely. The tail of F. borealis is notched at its end. The significance of lacking or presence of amphi-(sub-)chordal cells is in my opinion uncertain. Subchordal cells in S. magnum were also not found. For other species too some authors make

remarks that these cells are sometimes difficult to see. The function of these remarkable cells is unknown, but they are supposed to be glandular. Perhaps the age and the developmental stage of the cells has an influence on their visibility. I was not able to correlate the absence of the cells with other features of the animal.

Some specimens showed a typical row of square cells, each of them bearing a dark-staining nucleus. These cells were lying apart from each other in a median position in the tail. This feature seems the same phenomenon as Lohmann (1896) described in F. gracilis. Describing the tail, Lohmann writes: (Lohmann, 1896:31) "Sehr auffällig sind ferner, die grossen, median gelegenen Chordawandzellen, welche wenigstens in konservirtem Zustande, die form gekrümmter, nahezu rechteckiger Plättchen besitzen." Lohmann gives pictures to illustrate this phenomenon (tabel III, fig. 3<sup>a</sup> and fig. 3<sup>b</sup>). These cells are not to be seen in all the specimens, but for example in slide 66 they are very obvious. The arrangement and shape of the gonads is also used as a diagnostic feature by many authors. Here we have to deal with the difficulty that features concerning the gonads are not always present. If the gonads are fully lacking, the trunk of these specimens makes an empty impression. The part of the trunk in front of the stomach is often only faintly coloured. Just behind the stomach develops a compact ovary; behind the ovary the testis develops, the latter being more elongate in shape. In initial stages an increasing number of stained (in the slides) spherical bodies appear, lying apart from each other. When maturing these bodies fuse, acquiring their mature shape.

#### 8 Fritillaria pellucida (Busch), 1851 (Pl. 5 fig. C)

This species occurred, in both areas considered, at few stations in very small numbers. The trunks of F. pellucida were very much damaged with the exception of one specimen, showing some details (slide 72). The drawing is based on this specimen in particular. The possibility to identify these specimens was almost exclusively to be found in the features of the tail. Adjacent to the muscleplates of the tail, there are four large pear-shaped amphichordal cells, lying apart from each other, two on either side of

the muscleplates. The presence of these cells is sufficient for identification. In the tip of the tail some specimens showed some more cells, more marginal in position. The arrangement of the gonads is asymmetrical, resembling the situation in F. borealis forma sargassi. The oesophagus is broader, the endostyl is bar-shaped, having the same breadth at every point.

9 Fritillaria formica Fol, 1872 (Pl. 5 fig. B)

This species was only found in area 1 (Aruba, Curacao, Bonaire). The number of specimens was very small. In this species I had to deal with even more damaged animals. The tail is long. The musculature is of unequal breadth. The broadest point is lying in the upper part. Then the breadth is decreasing very slow, and the muscleplates are ending in a perfectly sharp point. How the transparent part of the tail runs I have not been able to establish precisely, but according to the literature it is the same as for the muscle plates. This species should have amphichordal cells, but they were not found. Very characteristic is the shape of the endostyl; it is fan-shaped. Often it could be observed quite well that the endostyl contains several large cells.

10 Fritillaria borealis forma sargassi Lohmann, 1905

F. borealis forma sargassi is a common form, but it does not occur in great numbers in the same samples. The identification did not give many problems. The tail of the species is most characteristic, bearing a broad musculature, particularly broad in the middle of the tail, narrowing at both ends in slight curves. The musculature does not end in a point. It makes the impression as if the tip has been cut off: the tip of the tail as a whole is notched, but it is often very difficult to see.

The trunk was often very much damaged. The oesophagus is longish, like in F. haplostoma. Often the gonads are completely lacking. Sometimes I found gonads arranged in the way of F.b. forma intermedia or of F.b. forma typica, but in those cases the gonads are small, and the specimens concerned all had the typical sargassi-shaped tails.

Only very few specimens showed the characteristic asymmetric arrangement of the matured gonads. These specimens were caught in late August at station 117. Also in other species I got the impression

that matured gonads were more often found in area 2 (Guyana), where the sampling had taken place later in the year than in area 1 (Aruba, Curacao and Bonaire).

11 Appendicularia sicula Fol, 1874

One tiny specimen of this species has been found in the sample of station 14. Although this species belongs to the Fritillariidae, its body resembles in many aspects that of the Oikopleuridae. The body is pear-shaped with a compact mass of intestine and gonads in the posterior part. Its big, pear-shaped rectum distinguishes it from its relative Appendicularia tregouboffi Fenaux, 1960. The endostyl is flattened, dorso-ventrally, broad near the mouth and narrow posteriorly; its extremities are curved upwards, just as in all other Fritillariidae. The tail proper is narrow, but it has broad flaps, in which two rows of clustered glandular cells are present. Distal part of the tail notched and bearing hairs.

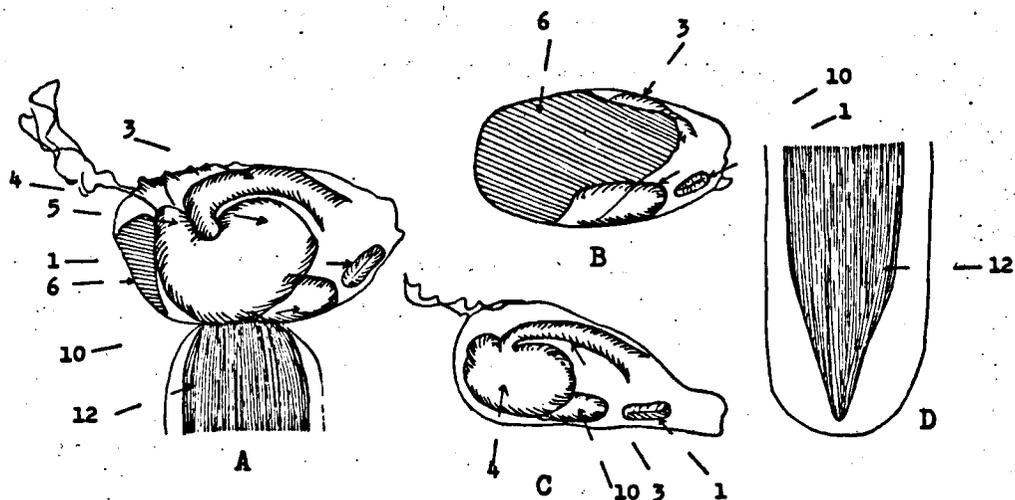
OCCURRENCE OF THE SPECIES AT THE STATIONS

0 Station 14 (neighbourhood of Curacao)

Nine species were found here. Date: May 20. The net was towed for only 20 minutes. Depth of the sea: 1100 m. About 350 specimens were caught. From these 350 specimens 155 were enclosed in slides and microscopically examined.

List of species:

1	<u>O. longicauda</u>	75 specimens certain and	25 specimens probable
2	<u>O. fusiformis</u>	15 " " "	1 " "
3	<u>O. fusiformis</u> f. <u>cornutogastra</u>	5 specimens certain	1 " "
4	<u>F. pellucida</u>	4 specimens	
5	<u>S. magnum</u>	2 " certain and	2 specimens "
6	<u>F. formica</u>	1 " " "	2 " "
7	<u>A. sicula</u>	1 "	
8	<u>O. dioica</u>	1 "	
9	<u>O. rufescens</u>	1 "	

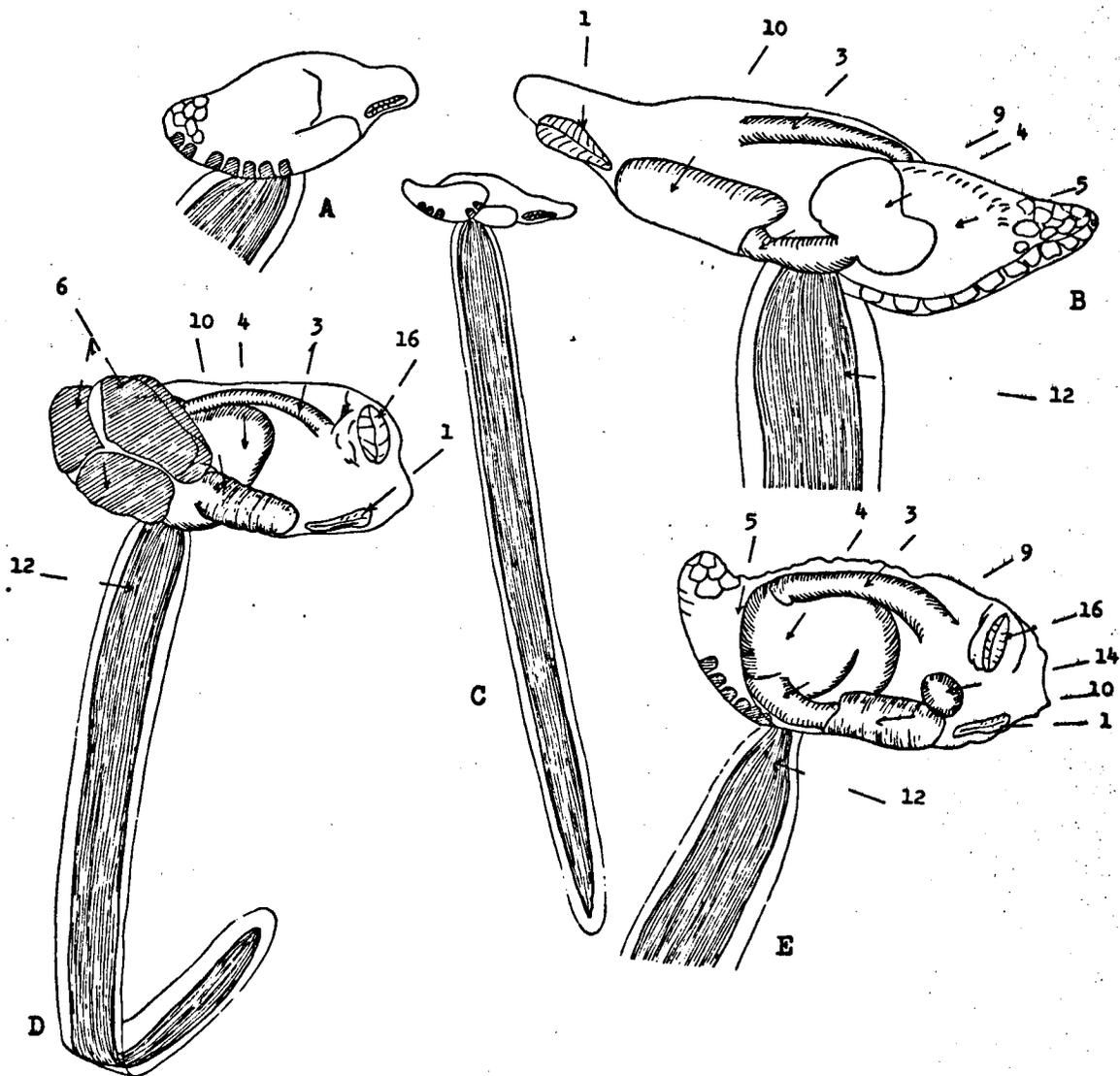


Pl. 1

- Fig. A O. longicauda, trunk  
 Fig. B O. longicauda, trunk with expanded gonads  
 Fig. C O. longicauda, trunk of aberrant type  
 Fig. D O. longicauda, tip of tail

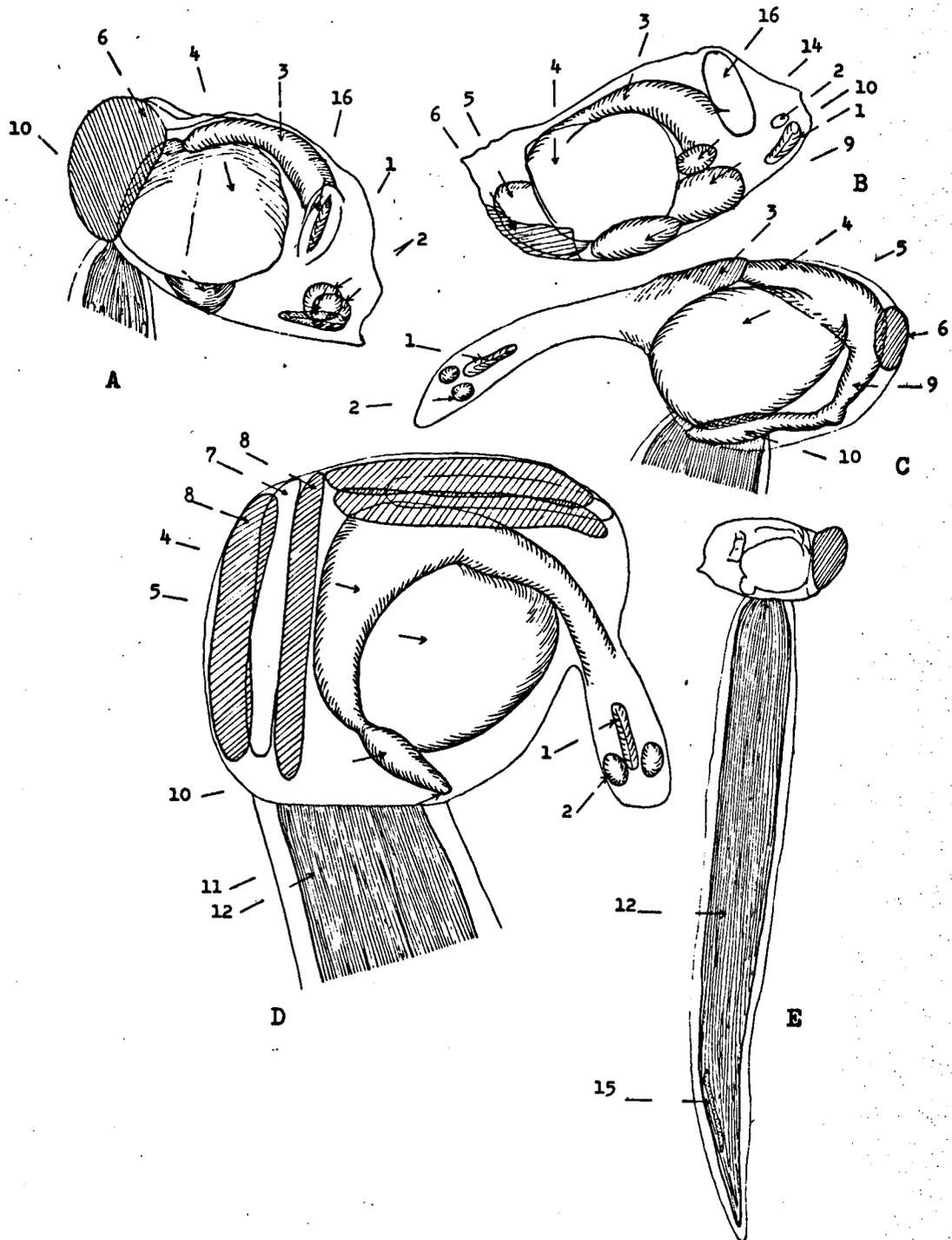
## Legend to all figures

- |                      |                                 |
|----------------------|---------------------------------|
| 1. endostyl          | 9. intestine                    |
| 2. buccal gland      | 10. rectum                      |
| 3. oesophagus        | 11. anus                        |
| 4. stomach           | 12. muscle plates               |
| 5. blindsac (caecum) | 13. mouth                       |
| 6. gonads            | 14. spiraculum                  |
| 7. ovary             | 15. amphi- or sub-chordal cells |
| 8. testis            | 16. Fol's oikoplast             |



Pl. 2

- Fig. A O. fusiformis, trunk, pointed, but not compact  
 Fig. B O. fusiformis, trunk, very slender type  
 Fig. C O. fusiformis, complete animal, with long tail  
 Fig. D O. fusiformis, complete animal, aberrant type (Stat. 177)  
 Fig. E O. fusiformis forma cornutogastra, trunk



Pl. 3

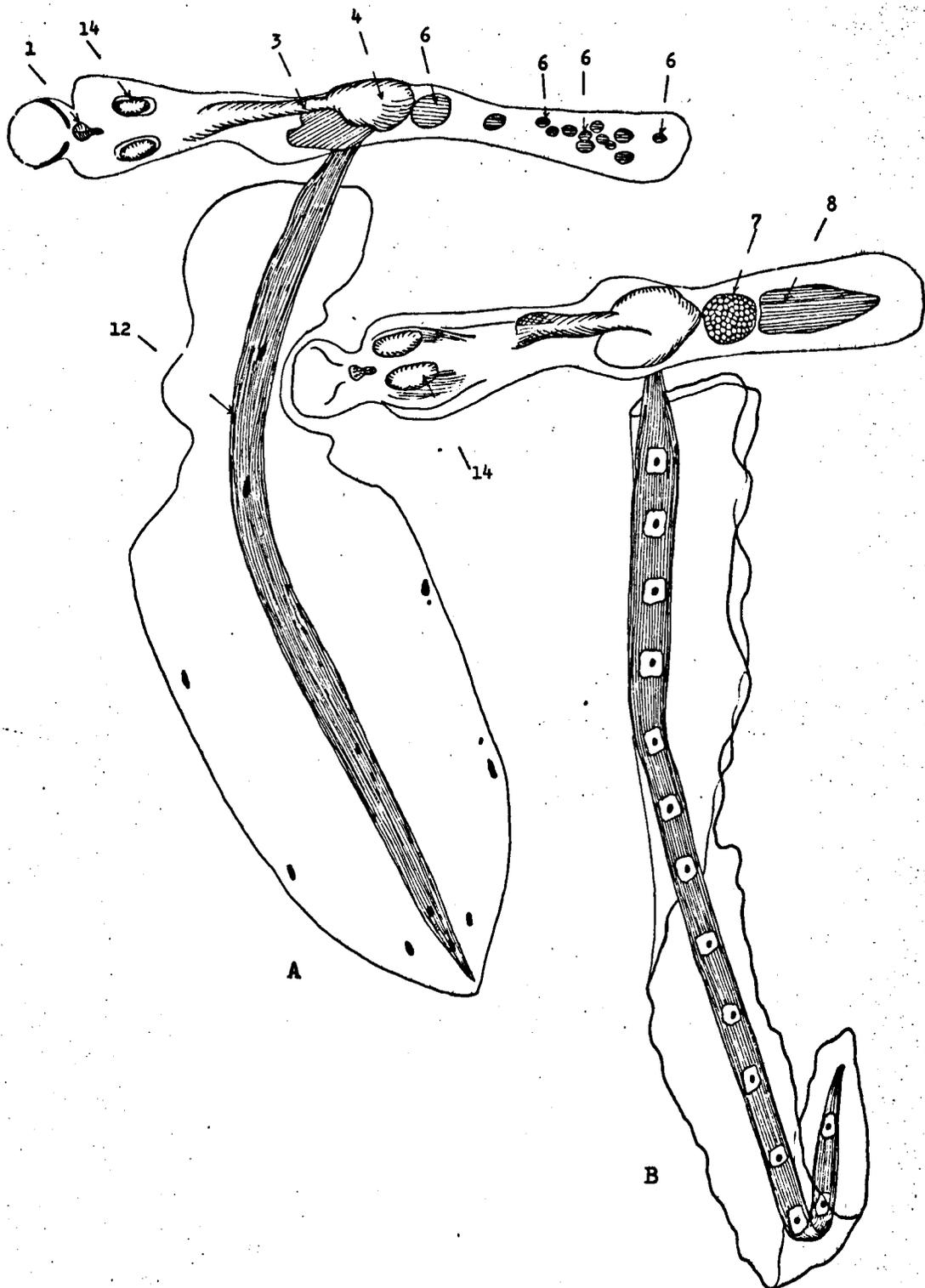
Fig. A O. rufescens, trunk

Fig. B O. dioica, trunk

Fig. C S. magnum, trunk, gonads very small

Fig. D S. magnum, trunk with "V"-shaped gonads

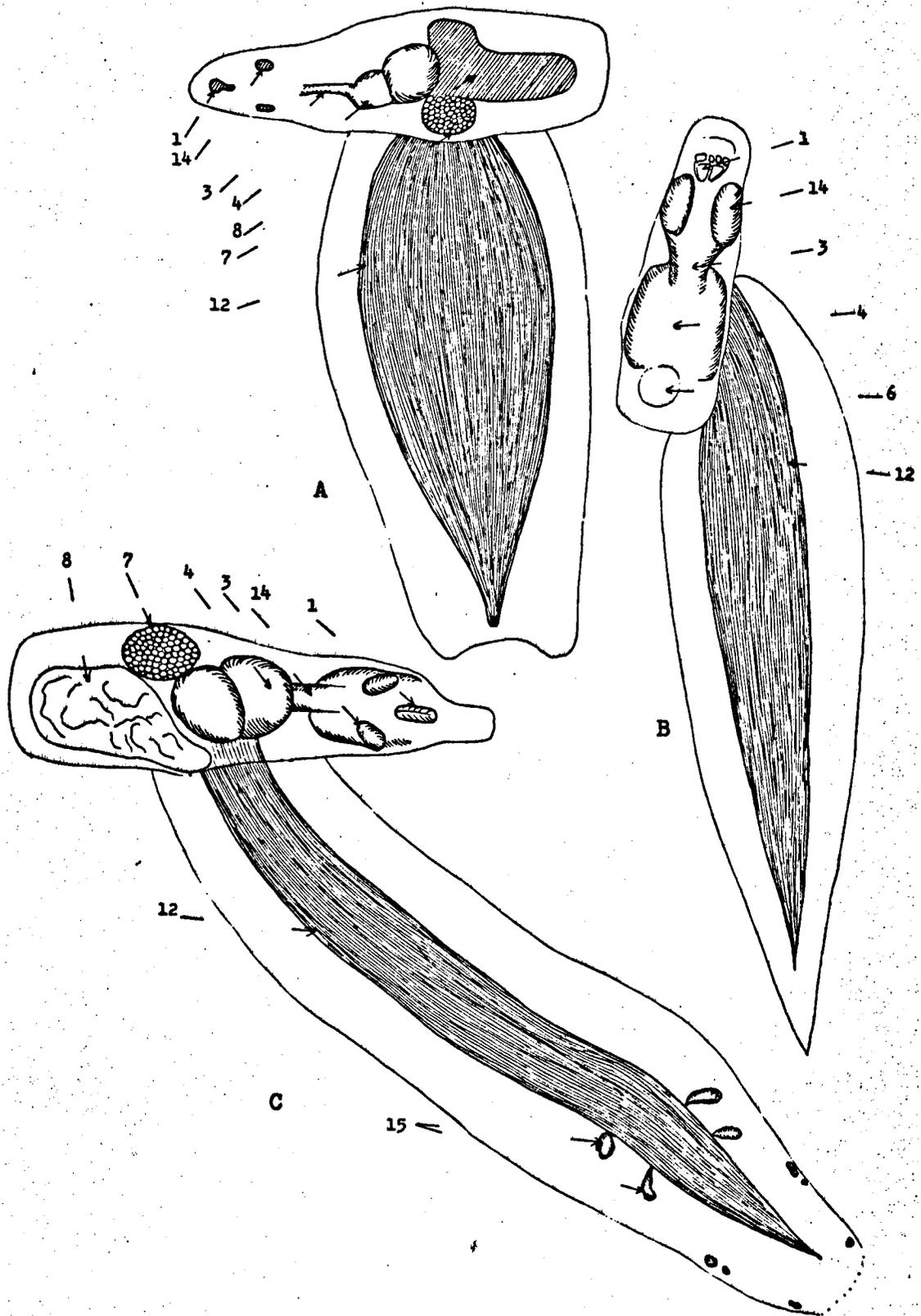
Fig. E O. rufescens, complete animal



Pl. 4

Fig. A F. haplostoma, animal with clear amphichordal cells and developing gonads.

Fig. B F. haplostoma, animal with mature gonads, row of cells in the chorda part of tail.



Pl. 5

Fig. A F. borealis forma sargassi, complete animal

Fig. B F. formica, complete animal

Fig. C F. pellucida, complete animal

25 specimens could not be identified at all. They were all Cikopleura-like. Some of them possessed buccal glands.

200 specimens were not examined by me. They were considered to belong to O. longicauda by Drs. R.W.M. van Soest. Specimens belonging to other species were selected from them as far as possible.

At this station the only specimen of A. sicula was found.

0 Station 30 (near Curacao)

This sample yielded 17 specimens. Date: May 26. The net was towed for 40 minutes. Depth: 1450 m. 4 specimens were mounted, 13 specimens considered to belong to O. longicauda were not.

List of species:

- 1 O. longicauda (not present in the slides)
- 2 O. fusiformis 2 specimens
- 3 O. dioica 1 specimen

0 Station 33 (near Curacao)

The net was towed for 55 minutes. Date: May 27. Depth: 1480 m. The sample contained only 6 specimens. They were all mounted.

List of species:

- 1 O. longicauda 2 specimens (certain) and 3 specimens (probable).
- One specimen could not be identified (O. spec.).

0 Station 42 (near Curacao)

The net was towed during 13 minutes. Date: June 13. This tow yielded only 3 specimens, all mounted in one slide.

List of species:

- 1 O. fusiformis (2 specimens)
- 2 O. spec. (1 specimen)

0 Station 45 (near Curacao)

The net was towed for 75 minutes. Date: June 15-16. Depth: 700-900 m. This tow yielded only one specimen. This specimen was not mounted.

List of species

- 1 O. longicauda (1 specimen)

0 Station 46 (near Curacao)

The net was towed for 25 minutes. Date: June 16. Depth: 700-800 m. This tow yielded only one specimen, mounted on a slide. It could not be identified.

List of species:

1 O. spec. (1 specimen)

0 Station 47 (near Curacao)

The net was towed during 55 minutes. Date: June 16. Depth: 820 m. The sample contained only one specimen. This one was not mounted.

List of species:

1 O. longicauda (1 specimen)

0 Station 48 (near Curacao)

The net was towed for 45 minutes. Date: June 16. Only one specimen was found. It was not mounted.

List of species

1 O. longicauda (1 specimen)

0 Station 51 (near Aruba)

The net was towed during 30 minutes. Date: June 18. Depth: 260 m. 4 specimens were found. One was mounted on a slide.

List of species:

1 O. longicauda (3 specimens)

2 F. borealis f. sargassi (1 specimen)

0 Station 53 (near Bonaire)

The net was towed during 120 minutes. Date: June 19-20. Depth: 100-260 m. A lot of specimens were caught. 24 specimens were mounted on 9 slides. Many specimens that were considered to belong to O. longicauda were not examined by me.

List of species:

1 O. longicauda (many specimens among which 6 on the slides and 1 probably belonging to this species)

2 S. magnum (9 specimens)

3 O. dioica (4 specimens)

4 F. borealis f. sargassi (2 specimens)

5 O. fusiformis (1 specimen)

6 O. spec. (1 specimen)

O Station 54

The net was towed for 120 minutes. Date: June 20. Depth: 420-588 m. 11 specimens were caught, mounted on 3 slides.

List of species:

1 <u>S. magnum</u>	5 specimens
2 <u>O. longicauda</u>	4 " certain + 1 specimen with some doubt.
3 <u>O. rufescens</u>	1 "

O Station 55

The net was towed for 120 minutes. Date: June 20. Depth: 580-760 m. 5 specimens were caught, 2 of them were mounted on one slide.

List of species:

1 <u>O. longicauda</u>	(2 present on a slide)
------------------------	------------------------

O Station 57

The net was towed for 105 minutes. Depth: 20 specimens were caught. They were not enclosed.

List of species:

1 <u>O. longicauda</u>	(20 specimens)
------------------------	----------------

O Station 58 (near Bonaire)

The net was towed for 120 minutes. Date: June 22-23. Depth: 280-415 m. 110 specimens were enclosed in 18 slides. About 50 specimens were not enclosed (mainly O. longicauda)

List of species:

1 <u>O. longicauda</u>	45 specimens (certain)	8 (probable)
2 <u>O. fusiformis</u>	5 " "	1 "
3 <u>O. fusiformis</u> f. <u>cornutogastra</u>	3 " "	
4 <u>O. rufescens</u>	3 " "	3 "
5 <u>O. dioica</u>	1 specimen	1 "
6 <u>S. magnum</u>	7 specimens	
7 <u>F. haplostoma</u>	1 specimen	
8 <u>F. pellucida</u>		
9 <u>F. spec.</u>	3 specimens	
10 <u>O. spec.</u>	28 "	

31 specimens could not be identified, among which 8 with buccal glands. The species F. pellucida was not found in the slides. Unfortunately some specimens got lost. Occurrence of F. pellucida is beyond doubt.

0 Station 59 (near Bonaire)

The net was towed for 120 minutes. Date: June 23. Depth: 696-960 m. 26 specimens were caught, 24 of them, mainly O. longicauda, were not examined by me. The other two specimens were enclosed in two slides and could not be identified satisfactorily.

List of species:

- 1 O. longicauda (24 specimens; not present in the slides)
- 2 O. spec. (1 specimen)
- 3 F. spec. (1 specimen)

0 Station 60 (near Bonaire)

The net was towed for 120 minutes. Date: June 23. Depth: 1284-1444 m. 16 specimens were enclosed in 2 slides. Many more specimens, mainly O. longicauda were not enclosed.

List of species:

- 1 O. longicauda 11 specimens present in the slides, 1 specimen probably
- 2 F. borealis f. sargassi (2 specimens)
- 3 F. formica (1 specimen)
- 4 F. haplostoma (1 specimen probable)

0 Station 61 (near Bonaire)

The net was towed for 120 minutes. Date: June 23. Depth: 1284-1444 m. The richest sample of all. Not less than 489 specimens were counted. They were all enclosed in 59 slides.

List of species:

- |  |     |                        |    |                 |
|--|-----|------------------------|----|-----------------|
| 1 <u>O. longicauda</u>                         | 228 | specimens certain      | 73 | with some doubt |
| 2 <u>O. fusiformis</u>                         | 135 | "                      | "  | 3 " " "         |
| 3 <u>O. fusiformis</u> f. <u>cornutogastra</u> | 6   | "                      | "  | 1 " " "         |
| 4 <u>O. dioica</u>                             | 1   | "                      | "  | 1 " " "         |
| 5 <u>S. magnum</u>                             | 5   | "                      | "  |                 |
| 6 <u>F. haplostoma</u>                         | 20  | "                      | "  | 2 " " "         |
| 7 <u>F. borealis</u> f. <u>sargassi</u>        | 38  | "                      | "  | 3 " " "         |
| 8 <u>F. formica</u>                            | 1   | "                      | "  | 1 " " "         |
| 9 <u>F. spec.</u>                              | 5   | "                      | "  |                 |
| 10 <u>O. spec.</u>                             | 66  | (3 with buccal glands) |    |                 |

0 Station 62 (near Curacao, west coast)

The net was towed for 120 minutes. Date: June 23. Depth: 220-520 m. The net contained only two specimens. They were enclosed in one slide.

List of species:

- 1 O. longicauda (1 specimen)  
2 O. fusiformis (1 specimen)

0 Station 69 (near Curacao, west coast)

The net was towed for 120 minutes. Date: June 27. Depth: . Only one specimen was found in this sample. It was enclosed in a slide.

List of species:

- 1 S. magnum (1 specimen)

0 Station 81 (near Curacao, west coast)

The net was towed for 25 minutes. Date: July 10. Depth: 470 m. This sample contained only one specimen. It was enclosed.

List of species:

- 1 O. rufescens (1 specimen)

0 Station 88 (near Curacao, west coast)

The net was towed for 120 minutes. Date: July 14. Depth: 430-740 m. Three specimens were found, all were enclosed in one slide.

List of species:

- 1 S. magnum (2 specimens)  
2 F. spec. (1 specimen)

0 Station 93 (near Bonaire)

The net was towed during 45 minutes. Date: July 16. Depth: 520-563 m. 24 specimens were found. They were all enclosed in 6 slides.

List of species:

- |   |                      |   |                    |   |                            |
|---|----------------------|---|--------------------|---|----------------------------|
| 1 | <u>O. longicauda</u> | 6 | specimens certain, | 5 | specimens with some doubt. |
| 2 | <u>O. fusiformis</u> | 6 | "                  | " | , 1 specimen " " "         |
| 3 | <u>O. rufescens</u>  | 4 | "                  | " | , 1 " " "                  |
| 4 | <u>O. cophocerca</u> |   |                    | 1 | " " "                      |

0 Station 97 (at some distance east of Aruba)

The net was towed for 87 minutes. Date: July 17. Depth: 390-648 m. At least 50 specimens were not examined by me, mainly O. longicauda. 6 specimens were enclosed in 3 slides.

List of species:

- 1 O. longicauda (not present in the slides)  
 2 O. dioica (1 specimen)  
 3 O. rufescens (1 " )  
 4 O. spec. (1 " )

0 Station 98

The net was towed for 65 minutes. Date: July 21. Depth: 1520 m. Only two specimens were collected. They were not enclosed.

List of species:

- 1 O. longicauda 1 specimen  
 2 O. rufescens 1 specimen

0 Station 111 (centre of area 2)

The net was towed for 90 minutes. Date: August 26. Depth: 42 m. This sample contained one specimen.

List of species:

- 1 F. borealis f. sargassi

0 Station 117 (eastern part of area 2)

The net was towed for 87 minutes. Date: August 27. Depth: 500 m. 23 specimens were collected. They were all enclosed in 3 slides.

List of species:

- 1 O. longicauda 10 specimens + 2 specimens with some doubt  
 2 O. rufescens 1 specimen " " "  
 3 F. borealis f. sargassi 4 specimens  
 4 S. magnum 2 "  
 5 O. fusiformis 1 specimen  
 6 O. spec. 1 "

0 Station 120 (central part of area 2)

The net was towed for 40 minutes. Date: August 28. Depth: 130 m. Two specimens were caught, both were enclosed in one slide.

List of species:

- 1 O. longicauda 1 specimen (with some doubt)  
2 O. rufescens 1 specimen

0 Station 123 (western part of area 2)

The net was towed for 60 minutes. Date: August 30. Depth: 98 m. 12 specimens were caught. They seemed all to belong to the species O. longicauda and were not enclosed.

List of species:

- 1 O. longicauda 12 specimens

0 Station 125 (western part of area 2)

The net was towed for 30 minutes. Date: August 31. Depth: 63 m. This sample contained about 20 specimens, 17 belonged to O. longicauda. Three specimens were enclosed in 3 slides.

List of species:

- 1 F. borealis f. sargassi (1 specimen)  
2 F. haplostoma (1 specimen)  
3 F. pellucida (1 specimen)  
4 O. longicauda (not present in the slides)

0 Station 127

The net was towed for 54 minutes. Date: August 31. Depth: 46 m. One specimen was found. This one was not enclosed.

List of species:

- 1 O. dioica (with some doubt)

0 Station 128

The net was towed for 65 minutes. Date: August 31. Depth: 32 m. 30 specimens were collected, two of them were enclosed. They were not examined by me.

List of species:

- 1 O. longicauda 30 specimens (2 present in the slides)

0 Station 130

The net was towed for 70 minutes. Date: August 31. Depth: 26 m. This sample contained only one specimen. It was enclosed in a slide.

List of species:

1 O. rufescens (1 specimen)

0 Station 133

The net was towed for 80 minutes. Date: September 1. Depth: 120 m. This sample contained about 22 specimens, 3 of them were enclosed.

List of species:

1 F. borealis f. sargassi (1 specimen)

2 F. haplostoma (1 specimen)

3 F. pellucida (1 specimen)

4 O. longicauda (± 19 specimens) not present in the slides

0 Station 144 (western part of area 2)

The net was towed for 115 minutes. Date: September 4. Depth: 500 m. Only one specimen was found. It was not enclosed.

List of species:

1 O. longicauda (1 specimen)

0 Station 147 (western part of area 2)

The net was towed during 25 minutes. Date: September 5. Depth: 47 m. 3 specimens were found. These were not enclosed and belonged probably to O. longicauda.

List of species:

1 O. longicauda (3 specimens, with some doubt)

0 Station 160 (eastern part of area 2)

The net was towed during 230 minutes. Date: September 26. Depth: 42 m. One specimen was found. This one was enclosed in a slide.

List of species:

1 O. spec. (1 specimen)

0 Station 164 (central part of area 2)

The net was towed during 80 minutes. Date: October 1.  
The sample contained 2 specimens, both enclosed in one slide.

List of species:

1 S. magnum (2 specimens)

0 Station 165 (central part of area 2)

The net was towed during 413 minutes. Date: October 2. Depth:  
64-58 m.

List of species:

1 F. pellucida (1 specimen)

2 O. fusiformis (3 specimens)

3 O. rufescens (1 specimen)

4 O. dioica (1 specimen, with some doubt)

5 O. spec. (1 specimen)

6 O. longicauda <sup>†</sup> 15 specimens. These 15 were not enclosed

0 Station 166 (central part of area 2)

The net was towed during 230 minutes. Date: October 2. Depth:  
64-58 m. This station was not examined by me. A lot of appendicu-  
larians were found here. They were not enclosed in slides. 169 spe-  
cimens.

List of species:

1 O. longicauda (many)

2 O. fusiformis (3 specimens)

3 O. cornutogastra (2 specimens)

It is possible that other species will be found among the O. longi-  
cauda.

0 Station 167 (central part of area 2)

The net was towed during 125 minutes. Date: October 3. Depth:  
520 m. The sample contained 30 specimens, probably all O. longicauda.  
These specimens were not examined by me.

List of species:

1 O. longicauda (30 specimens)

0 Station 175 (central part of area 2)

The net was towed during 180 minutes. Date: October 14.  
This station was not examined by me. 85 specimens were caught,  
most of them belonged to O. longicauda.

List of species:

1 O. longicauda (many)

0 Station 176 (central part of area 2)

The net was towed during 125 minutes. Date: October 22.  
A few O. longicauda were not enclosed, two specimens were enclosed  
in two slides.

List of species:

1 O. longicauda (1 specimen in the slides)

2 O. rufescens (2 specimens)

0 Station 177 (central part of area 2, near the coast)

The net was towed during 30 minutes. Date: October 23. Depth:  
16 m. 149 specimens were caught. 58 of them were enclosed in 9  
slides. 91 specimens (O. longicauda) were not.

List of species:

1 O. longicauda many specimens, only two doubtful ones in the  
slides.

2 O. fusiformis 44 specimens

3 F. haplostoma 8 specimens

4 O. spec. 4 specimens (in the slides)

The O. fusiformis specimens were all of a special type with a very  
short tail, having a narrow musculature.

0 Station 178 (central part of area 2)

The net was towed during about 30 minutes. Date: October 24.  
Depth: 16 m. 7 O. longicauda were caught. This sample was not  
examined by my.

List of species:

1 O. longicauda (7x)

0 Station 181 (eastern part of area 2)

The net was towed during 155 minutes. Date: October 25. Depth: 76 m. This sample yielded 3 specimens, belonging to O. longicauda. These specimens were not examined by me.

List of species:

1 O. longicauda (3 specimens)

0 Station 184 (eastern part of area 2)

The net was towed during 62 minutes. Date: October. Depth: 4020 m. 2 specimens were found. They were not enclosed.

List of species:

1 O. longicauda 1 specimen

2 O. spec. 1 specimen

0 Station 186 (eastern part of area 2)

The net was towed during 40 minutes. Date: October 28-29. Depth: 4240 m. 2 specimens were found. Both were enclosed in one slide.

List of species:

1 O. rufescens 1 specimen certain, 1 specimen with some doubt.

0 Station 187 (eastern part of area 2)

The net was towed during 50 minutes. Date: October 29. Depth: 4330 m. This sample yielded one specimen.

List of species:

1 O. rufescens (1 specimen)

0 Station 189 (eastern part of area 2)

The net was towed during 46 minutes. Date: October 29. Depth: 4400 m. This tow yielded 5 specimens. Two of them were enclosed in one slide.

List of species:

1 O. longicauda 3 specimens (these were not examined by me)

2 O. rufescens 2 specimens

0 Station 190 (north-eastern part of area 2)

The net was towed during 55 minutes. Date: October 29. Depth: 4440 m. This sample yielded about 20 specimens. They were not examined by me. The bulk of them belonged to O. longicauda.

0 Station 199 (north-west of Trinidad)

The net was towed for 75 minutes. Date: November 3. 2 specimens were found. They were not examined by me.

List of species:

1 C. longicauda (2 specimens)

0 Station 201 (area 1, north of the islands)

The net was towed for 375 minutes. Date: November 14. Depth: 3240-2950 m. This sample yielded 3 specimens. They were all enclosed in one slide.

List of species:

1 O. rufescens (1 specimen)

2 S. magnum (1 specimen)

3 O. spec. (1 specimen)

0 Station 202 (area 1, north of the islands)

The net was towed for 510 minutes. Date: November 16-17. Depth: 3730-3976 m. Two specimens were found. They were not examined by me.

List of species:

1 O. longicauda (2 specimens)

0 Station 203 (area 1, north of the islands)

The net was towed for 395 minutes. Date: November 18. Depth: 2496-2347 m. 2 specimens were found. They were not examined by me.

List of species:

1 O. longicauda (2 specimens)

0 Station 204 (area 1)

The net was towed for 365 minutes. Date: November 19. Depth: 2328-2064 m. 2 specimens were found. They were not examined by me.

List of species:

1 O. longicauda (2 specimens)

0 Station 205 (area 1, north of the islands)

The net was towed for 355 minutes. Date: November 20. Depth: 1836-1640 m. 3 specimens were found. They were enclosed in one slide.

List of species:

1 S. magnum (3 specimens)

0 Station 206 (just between Curacao and Aruba)

The net was towed for 470 minutes. Date: November 21. Depth: 1160-632 m. This tow yielded 1 specimen, enclosed in a slide.

List of species:

1 O. longicauda (1 specimen)

0 Station 207 (in the north of area 1)

The net was towed for 145 minutes. Date: November 26. Depth: 2270 m. The sample contained 2 specimens. They were both enclosed in one slide.

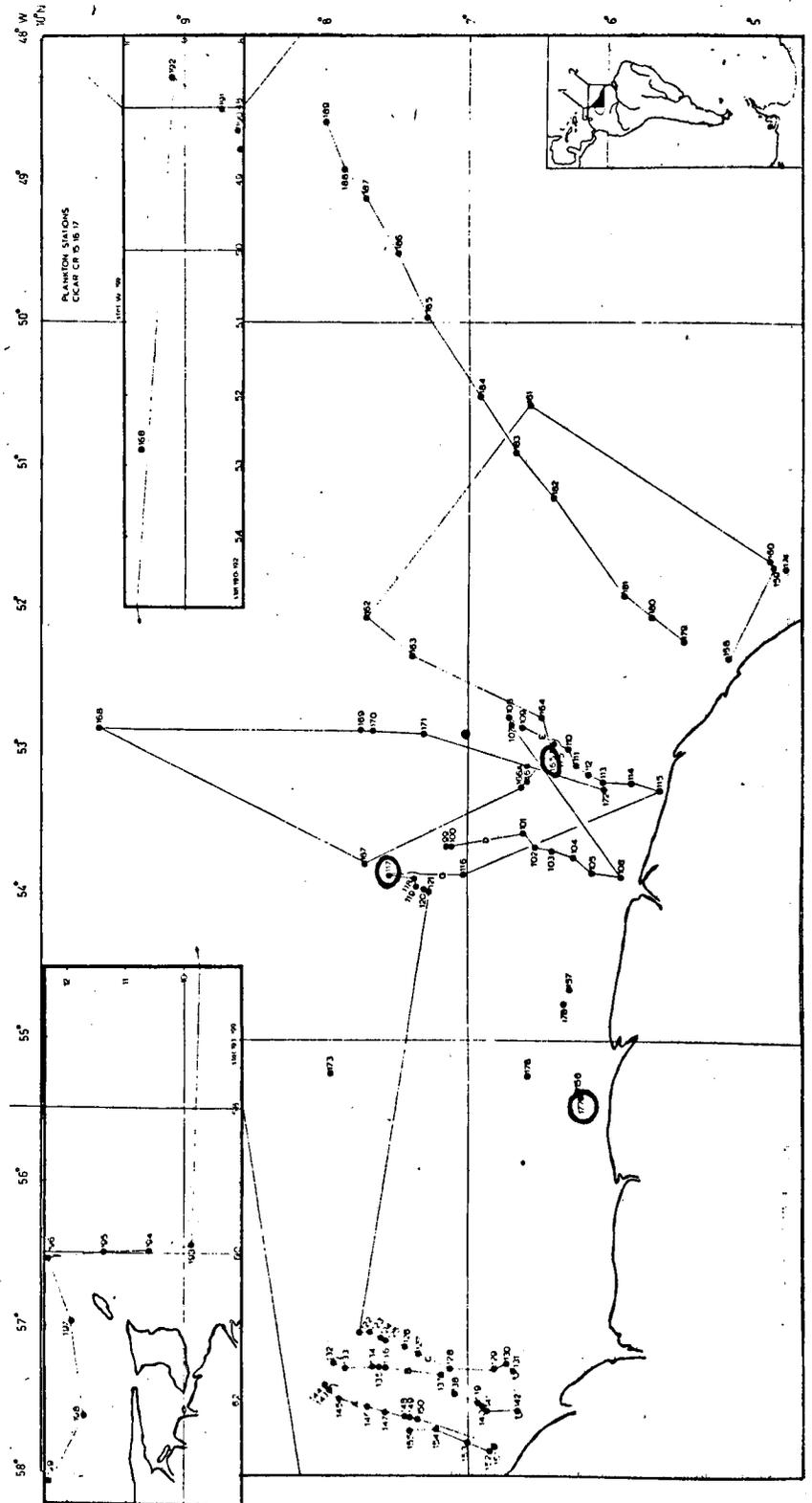
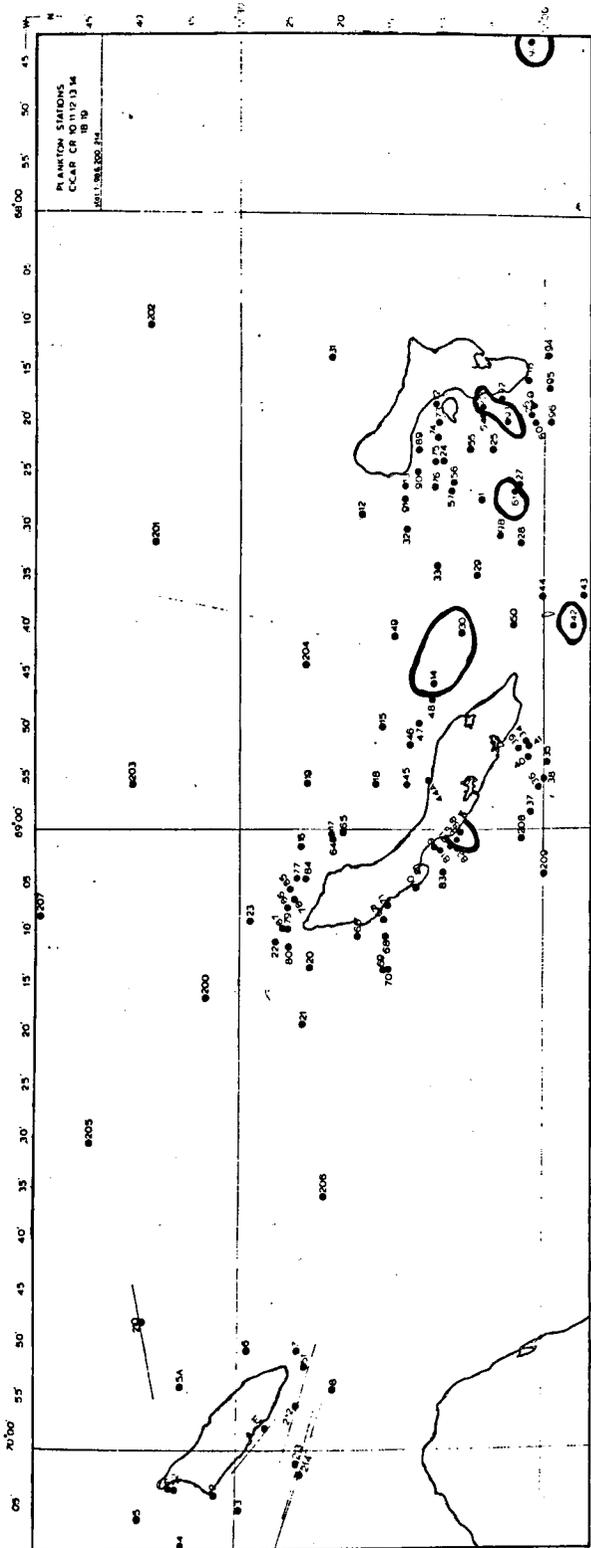
List of species:

1 O. rufescens (1 specimen)

2 O. longicauda (1 specimen)



*Oikopleura fusiformis*

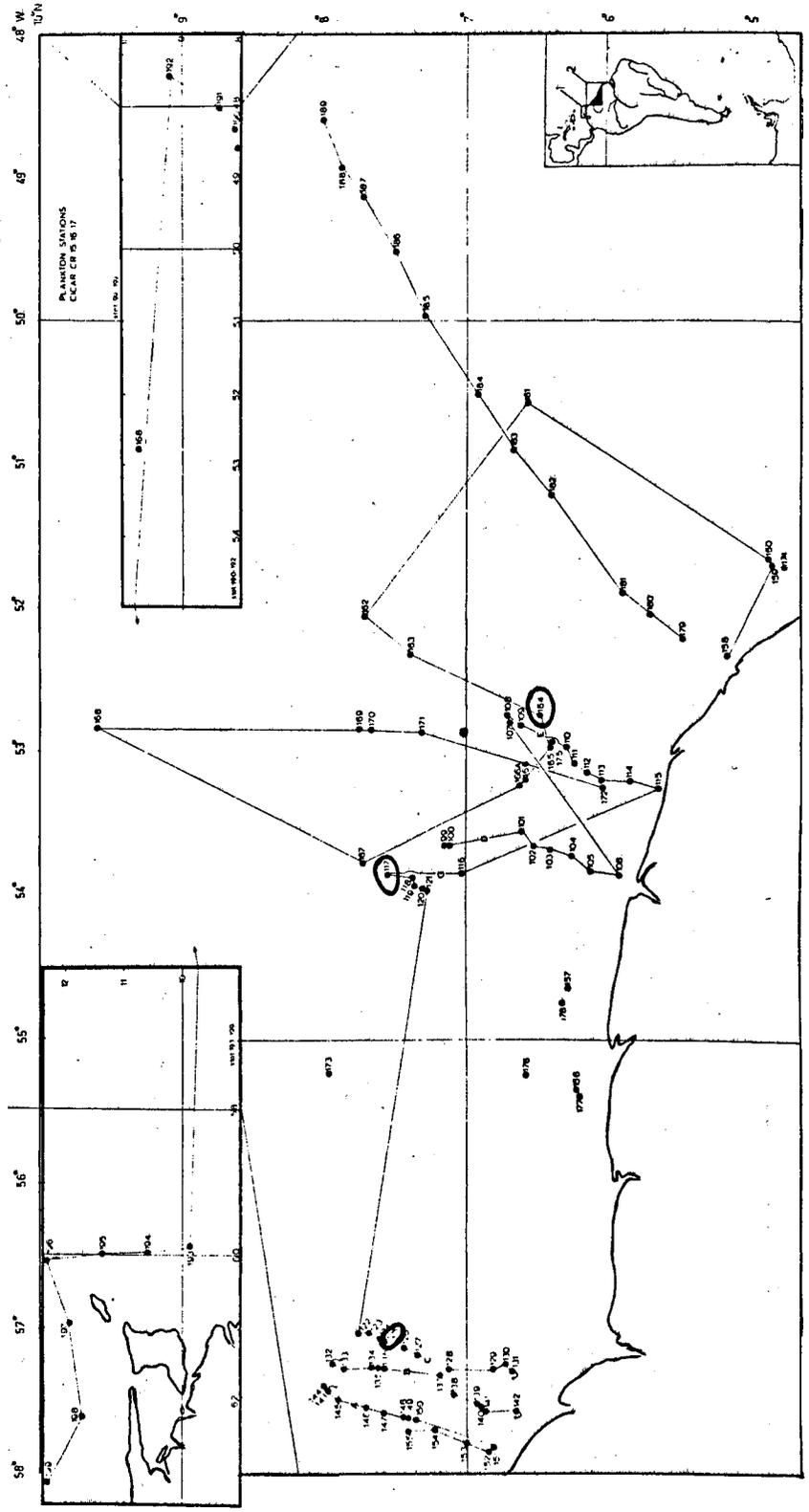
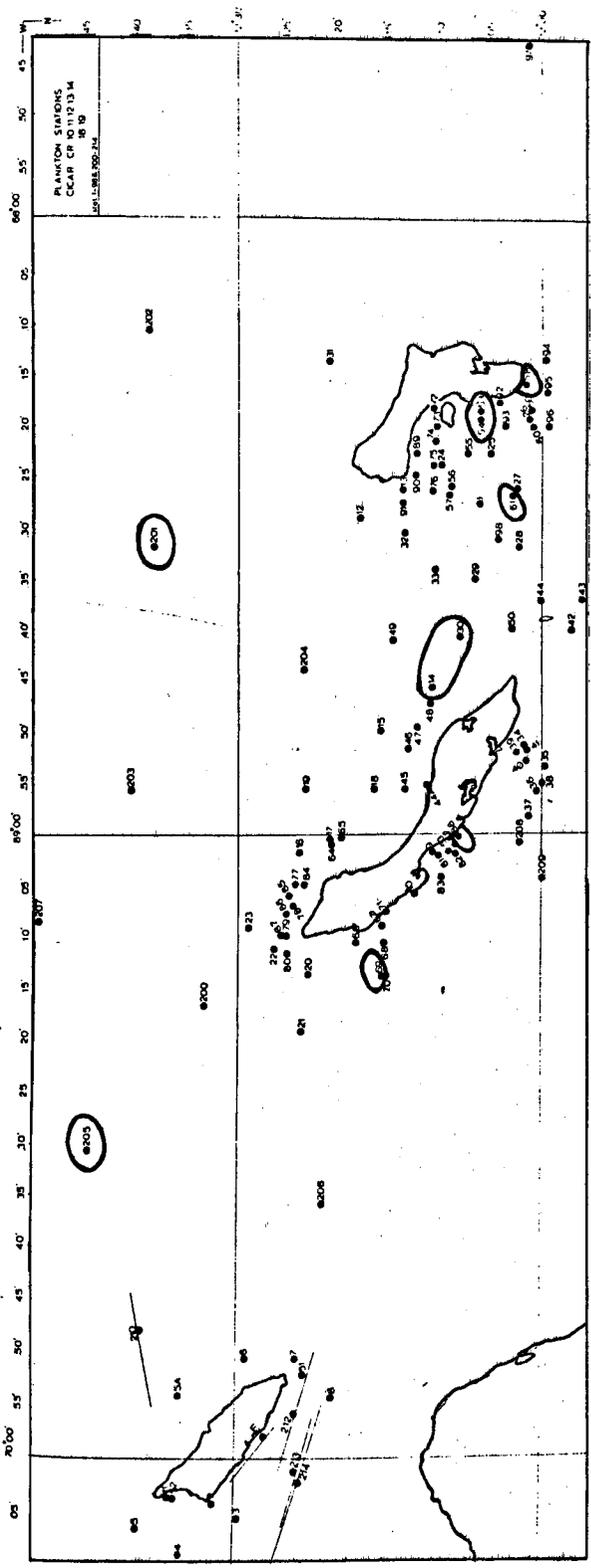




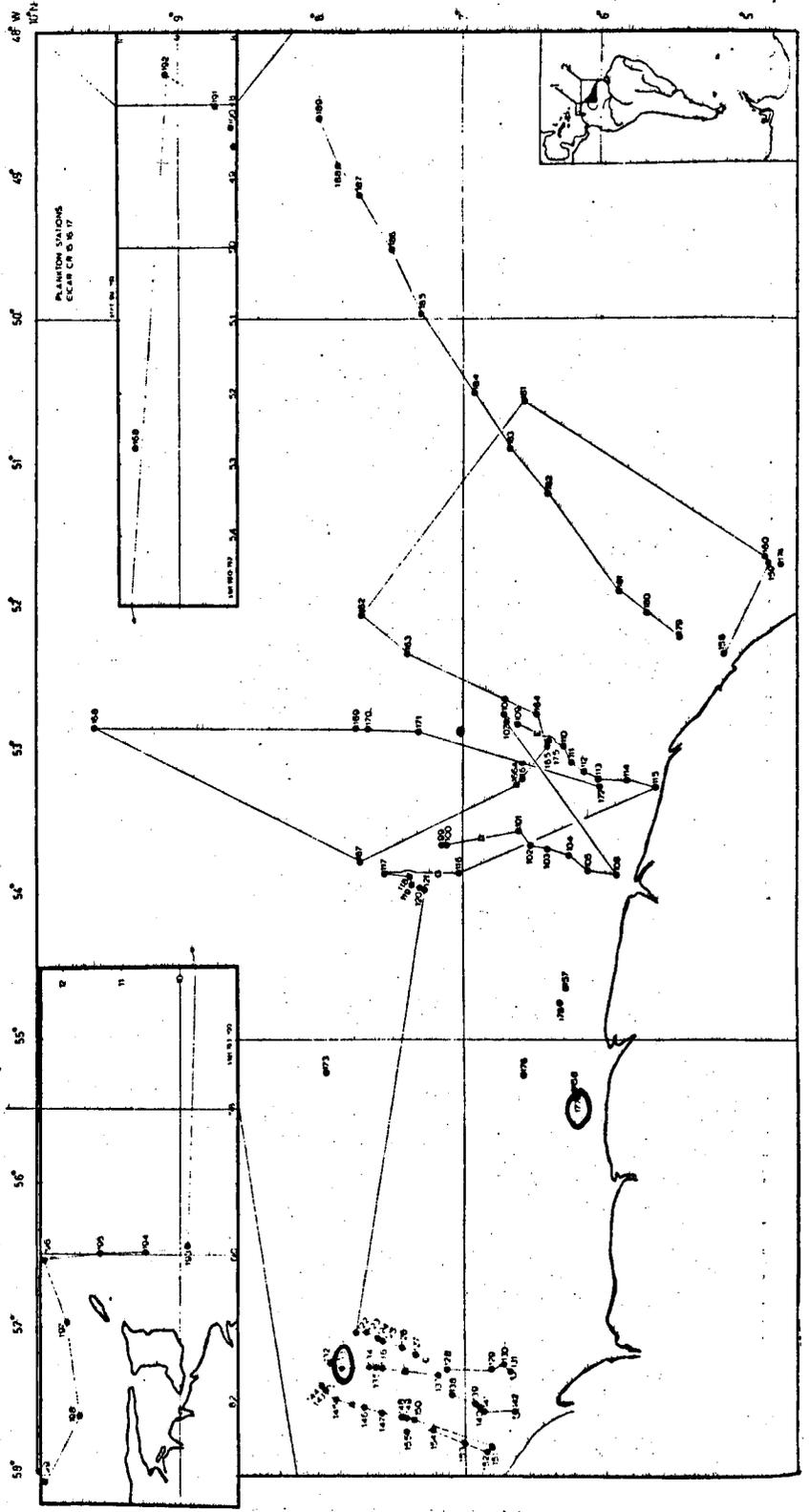
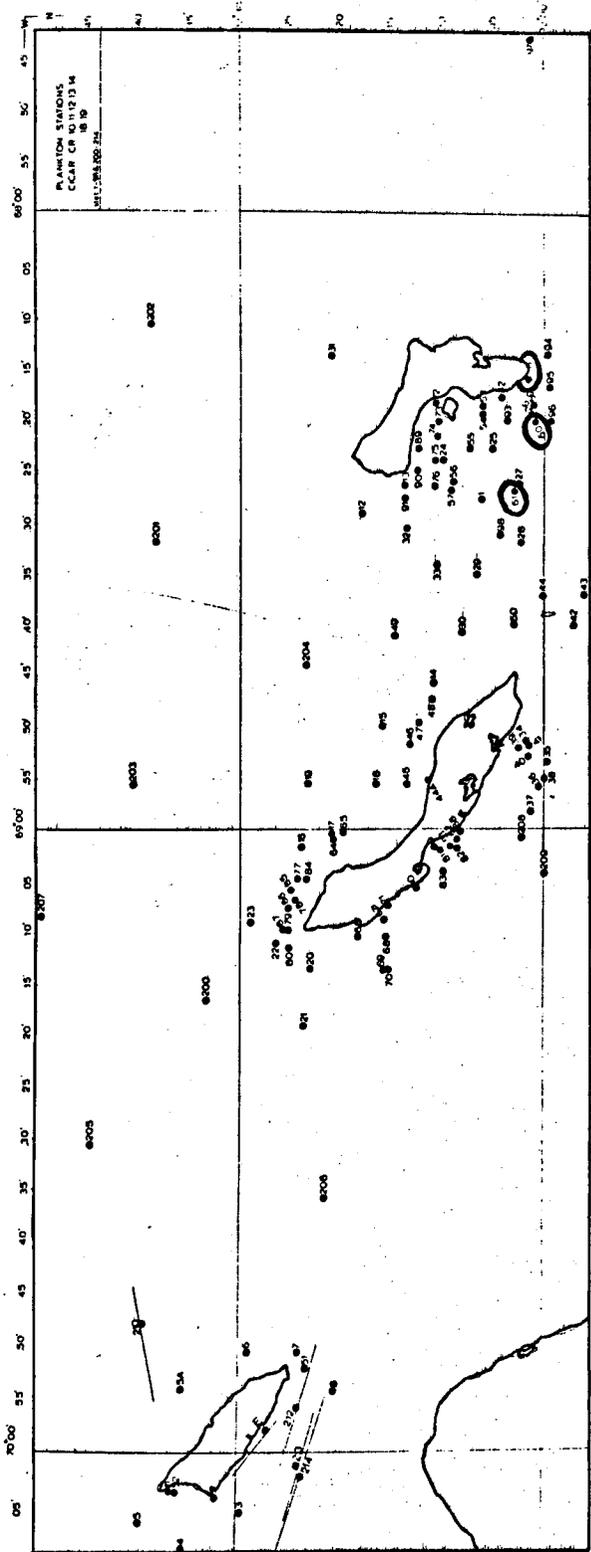




Stegosoma magnum

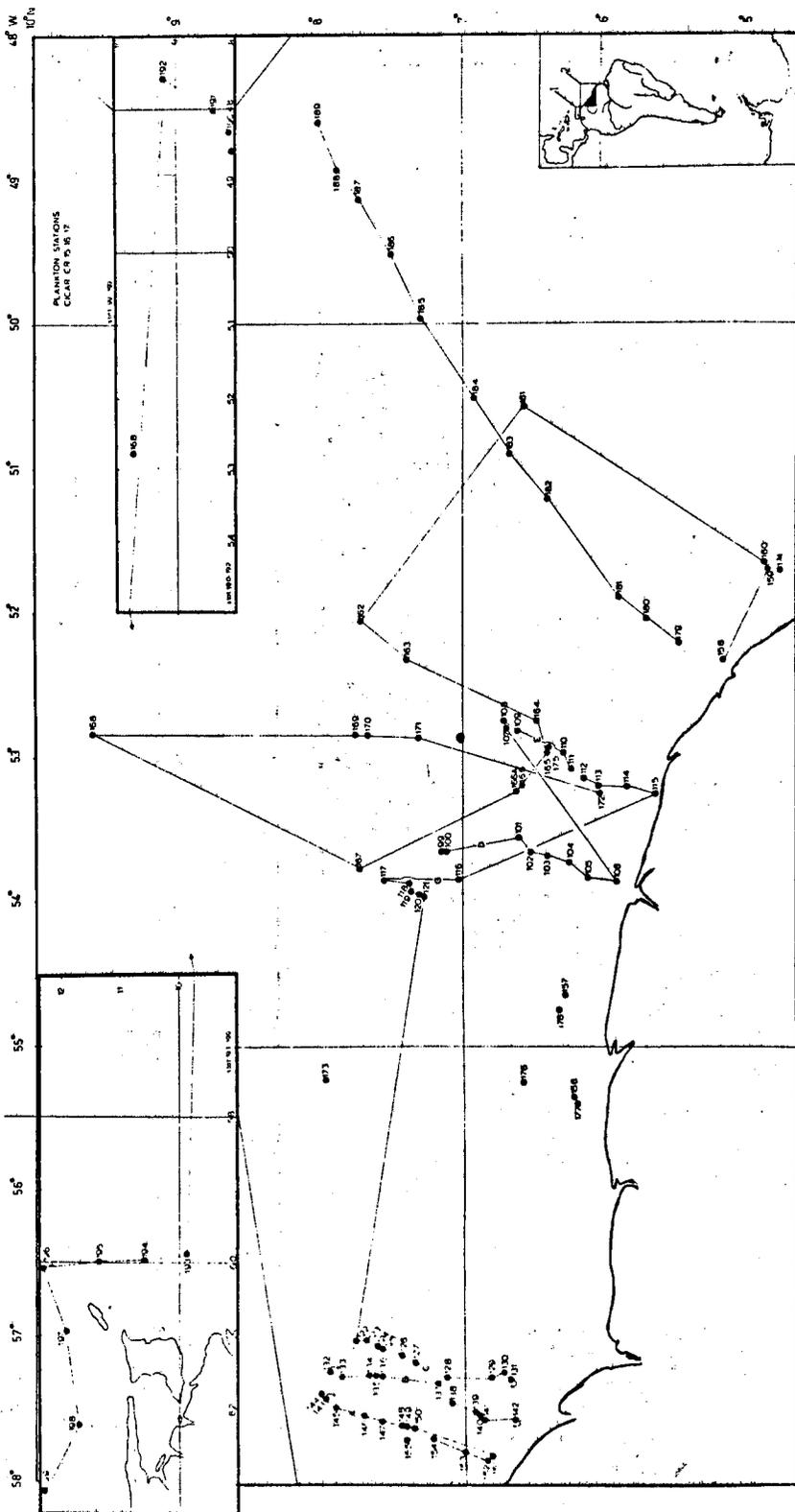
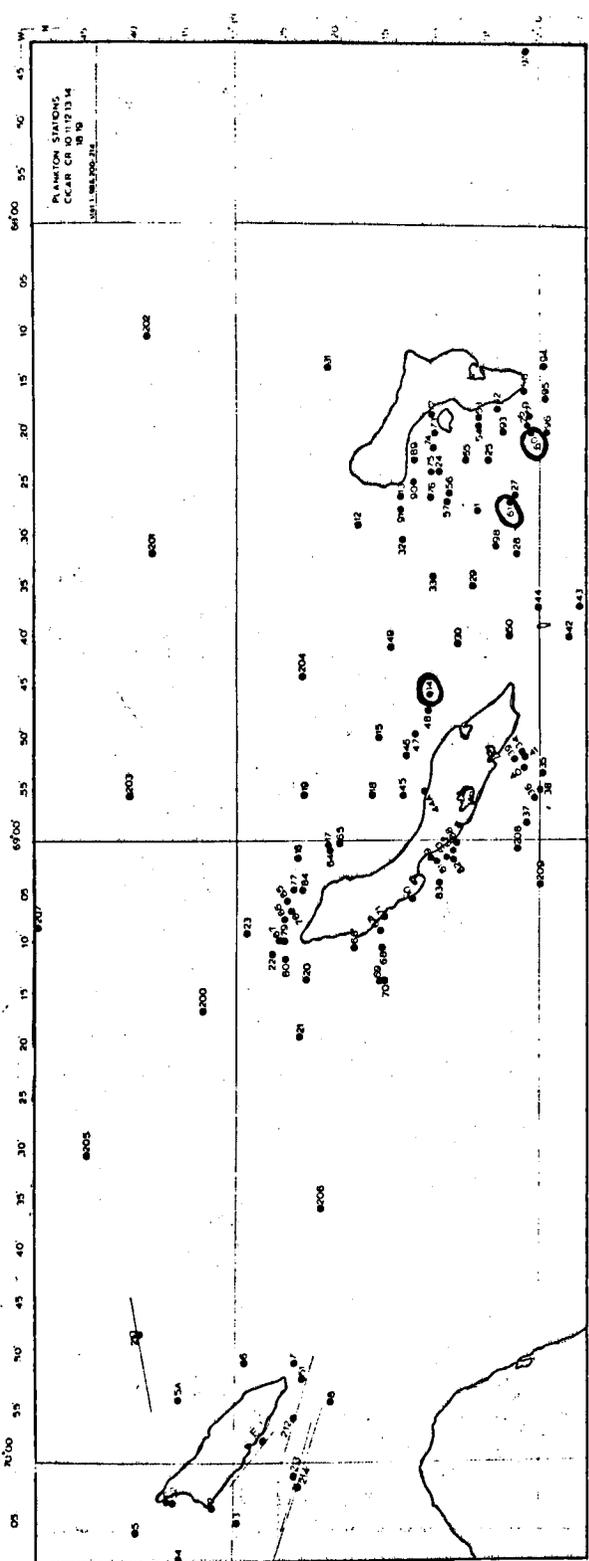


*Fritillaria haplostoma*

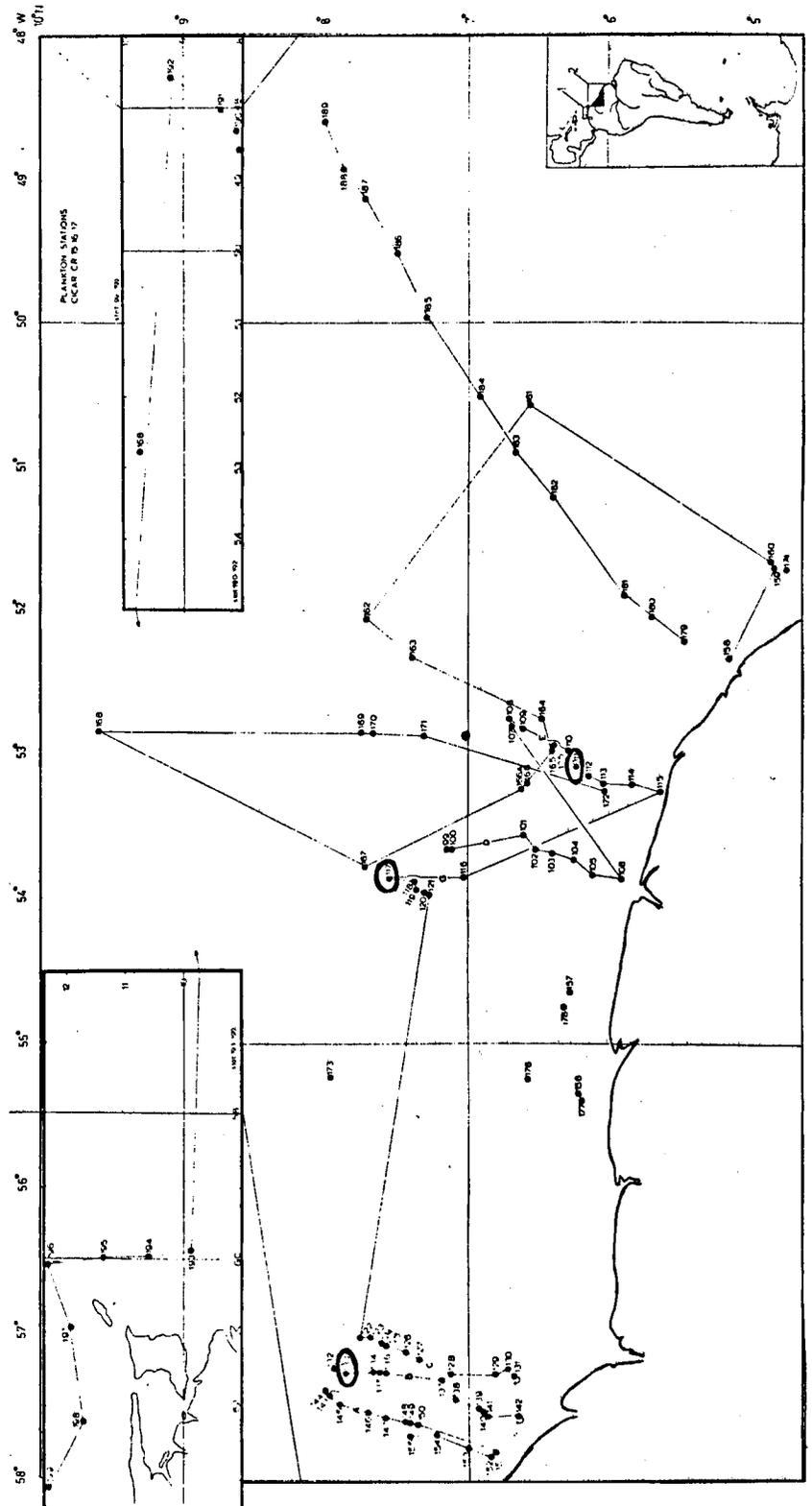
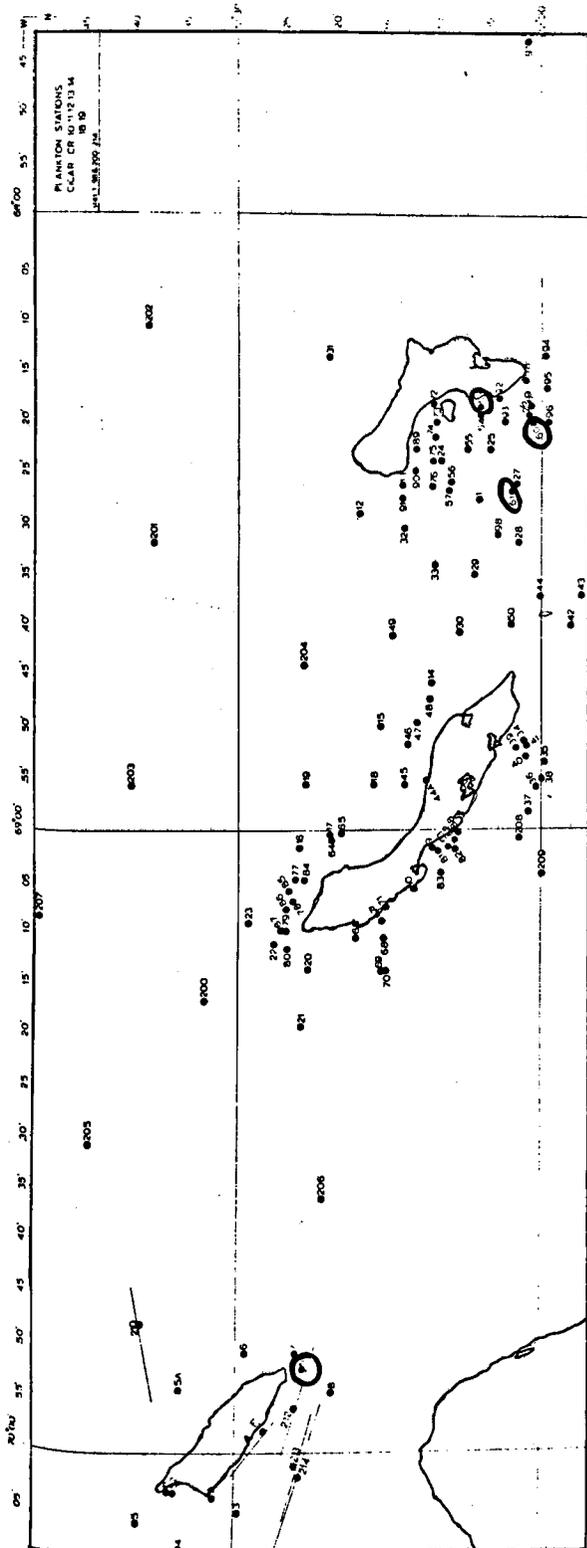




Fritillaria formica



*Fritillaria borealis* forma *sargassi*



## DISTRIBUTION

The simplest explanation for the occurrence of a species as well as its abundance is, that in areas where the species is found, the conditions are more favourable than in areas where the opposite is true. Looking at the given distribution maps, it is, however, not allowed to establish fixed favourable areas and obviously unfavourable. One reason for this is, that the water in which the animals live, is moving. This is true in both areas and the direction is the same (N/W, parallelling the north coast of South America). It is by no means certain that planktonic animals are able to remain at the same location, though it is not completely out of the question. So if there is any difference somewhere in the areas, we should realise that we are dealing with a snapshot. The situation at the same location might be different some days later.

For a part of area 2 (central and eastern part) some hydrographical data were available, collected at the time of sampling. Troost (1973) tried to characterize the waters in which the animals were caught. He distinguished three types of water, mainly characterized by the salinity and the temperature at the surface. One type of water has a low salinity and high temperature. This water is influenced by the discharge of rivers. A second type has a high salinity and relatively low temperature. Further he distinguished an intermediate type of water, thought to be the result of mixture. The low salinity ( $29,6^{\circ}/\text{oo}$ ) is mainly caused by the discharge of the Amazon river. There is some evidence, that the influence of the Amazon river is not causing the occurrence of uniform areas of low-salinity water, but results to fields of low-salinity water drifting in N/W direction, surrounded by water of different T/S relation. This seems at least true in the area off de coast of Guyana, because temperature measurements at the same location occasionally yielded differences of several °C in but a few hours.

For more than one reason the observations made, are a snapshot. There are not only short-time changes, but also seasonal influences. The discharge of the Amazon river varies considerably throughout the year. In summer this is high (May-June). In winter it is low.

In the hydrographical atlas compiled by Wüst (1964) average surface salinities for summer and autumn on the one hand and for winter and spring on the other hand are given. In the summer season in the southern part of the Caribbean a large low-salinity tongue is present. In the intermediate neighbourhood of the coasts the situation is more complicated. The salinity here is often higher, which is probably the result of upwelling.

Attempts to relate species to the above mentioned three types of water, failed with the presently available data. It must be said that the samples were very poor in area 2 as a whole, which makes these observations less valuable. Perhaps it is interesting to note that the capture of a different type of O. fusiformis occurred in high salinity-low temperature water (upwelling). This sample was relatively rich (station 177). In some parts of area 1 both the number of specimens and the number of species caught at a station were often higher. One might wonder whether this difference is caused by the season. In area 2 none of the samples was made earlier than late July, some even in December. In area 1 the first samples were made in the second half of May, most of them in June, some in July. The stations (201-207 and 214<sup>A</sup>) near the islands are an exception, but these were very poor, just as those in area 2. The samples were taken in November here. Supposing that the main change in the environment is the salinity, then there is no reason for a species as O. longicauda to occur in great numbers. This species occurs according to Lohmann (1896) very abundant in the mouth of the Amazon river (<sup>†</sup> 12,8‰ salinity is not uncommon).

O. dioica is also able to live in the Amazon mouth, even in lower salinity than O. longicauda does. So a simple explanation for differences in abundance between the two areas cannot be given. When abundance is concerned, it must be kept in mind, that the sampling was not uniform. The duration of the net tows was different. It is possible that some species avoid low-salinity water, for example O. rufescens. More extensive investigations are necessary. Looking at the species composition of both areas as a whole, we see that in area 2 three species are entirely lacking: O. cornutogastra, F. formica and A. sicula.

Considering that these species in area 1 were represented by very few specimens and that the samples in area 2 were poor, one should conclude this observation to be of little value. It is a remarkable fact that the samples yielding the greatest number of specimens, also contained the greatest number of species.

The animals live in clouds. In neighbouring stations, where the net was towed in the same week, the samples were in one case rich, in the other nearly or entirely negative. It is perhaps noteworthy that the area immediately between the islands Curacao and Bonaire yielded the richest samples and that all the other stations seem as poor as in area 2.

LITERATURE

- Berrill, N.J., 1950. The tunicata with an account of the British species - Ray Society, London: 1-354.
- Björnberg, T.K.S. & Forneris, L., 1955. Resultados científicos do cruzeiro do "Baependi" e do "Vega" a ilha de Trindade - Oceanogr. biol., Universidade de São Paulo, 1: 1-68.
- Bückmann, A., 1969. Appendicularia - Fich. Identif. Cons. Int. Explor. Mer, Plankt. Sh. 7: 1-9.
- Cicar. First Interim Report 1971 (unpublished).
- Fenaux, R., 1967. Les appendiculaires des mers d'Europe et du Basin Méditerranéen - Faune Europe Basin Médit. 2: 1-113.
- Lohmann, H., 1896. Die Appendicularien der Plankton-Expedition - Wiss. Ergebn. Deutsch. Tiefsee Exp. II: 1-148.
- Thompson, H., 1948. Pelagic Tunicates of Australia - Commonwealth Council for Scientific and Industrial Research, Melbourne: 1-176, 75 pls.
- Troost, D.G., 1973. Onderzoek aan enkele groepen uit het plankton verzameld in het kader van "Cooperative Investigations in the Caribbean and Adjacent Regions" - Verslagen technische Geg., Inst. Tax. Zool. Universiteit van Amsterdam 1: 1-93 (mimeographed).
- Waard-Pouw, G. van & Soest, R.W.M. van, 1973. A bibliography of Pelagic Tunicates - Verslagen technische Geg., Inst. Tax. Zool. Universiteit van Amsterdam: 1-148 (mimeographed).
- Wüst, G., 1964. Stratification and circulation in the Antillean-Caribbean basins - Columbia University Press, New York + London 1: 1-201, 22 pls.
- Zoppi de Roa, E., 1971. Appendicularias de la region oriental de Venezuela - Stud. Fauna Curacao Caribbean Isl., 28: 1-115.

<u>INHOUD</u>	pag
Resultaten van het plankton onderzoek met behulp van pomponsters in het kader van het Cicar (Cooperative Investigations in the Ca- riibbean and Adjacent Regions) project.	1
<u>Inleiding</u>	1
Methodiek	2
Hydrografie in het gebied voor de kust der Guyana's	5
Hydrografie in het Caraïbische gebied	7
<u>Resultaten I</u>	8
Volume en kleur van monsters voor de kust der Guyana's	10
Verhouding zand, detritus, phyto- en zooplankton	25
Soorten samenstelling	34
Gemiddelde grootte van twee Coscinodiscus soorten	43
<u>Resultaten II</u>	47
Volume en kleur van de monsters in het Caraïbische gebied	47
Verhouding zand, detritus, phyto- en zooplankton	48
Soorten samenstelling	51
<u>Discussie</u>	53
<u>Samenvatting</u>	55
<u>Summary</u>	57
<u>Literatuur</u>	60
Preliminary results on appendicularians from the Cicar (Coopera- tive Investigations in the Caribbean and Adjacent Regions) project	63
<u>Introduction</u>	63
Material and methods	64
Staining	64
<u>Results</u>	65
List of species	65
Brief description of the species	65
Occurrence of the species at the stations	73
Distribution	102
<u>Literature</u>	105

