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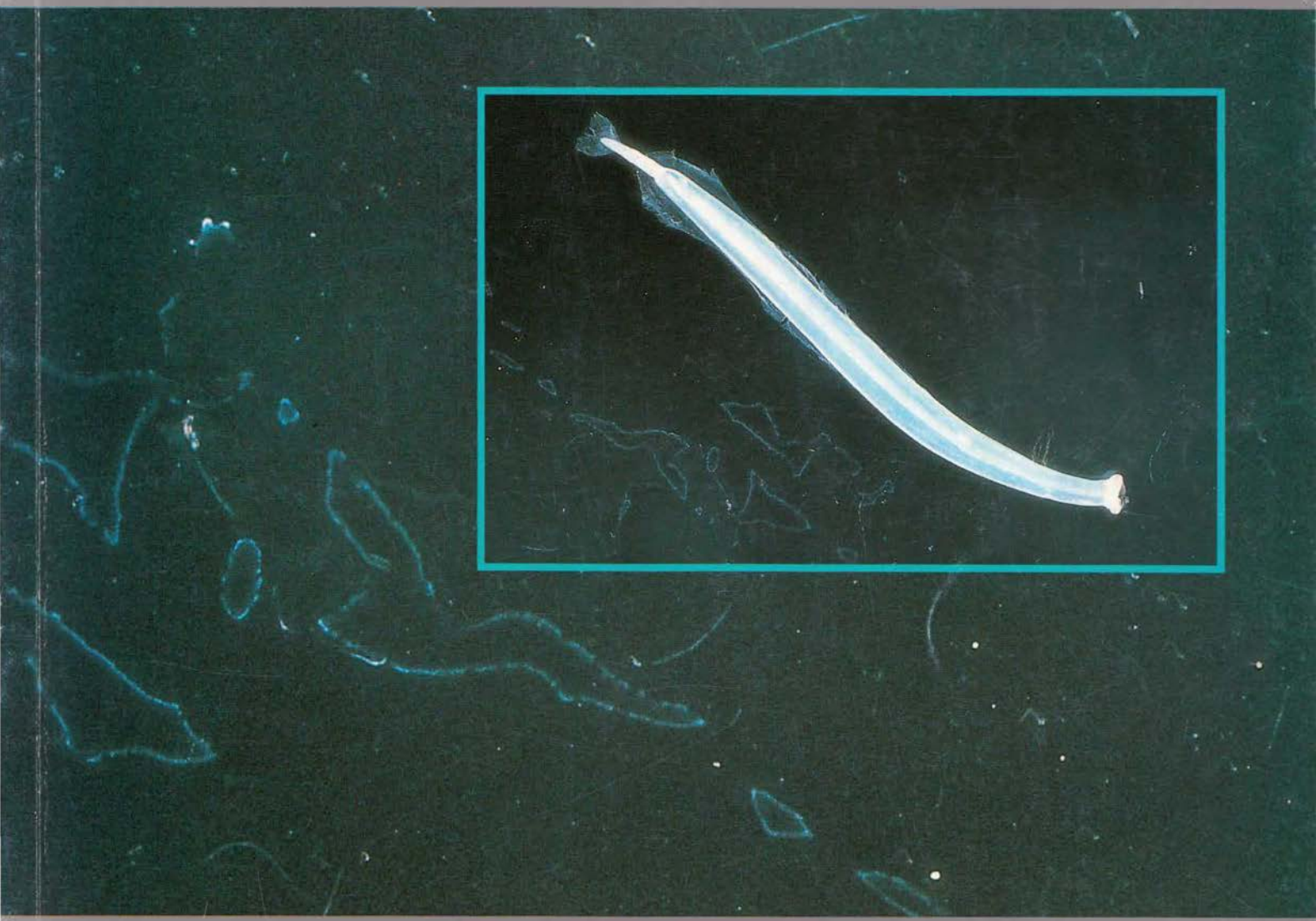

The Marine Fauna of New Zealand:

Chaetognatha (Arrow Worms)

Sigrid Lutschinger

New Zealand Oceanographic Institute Memoir 101

COVER PHOTO. *Pseudosagitta gazellae* (Ritter-Záhony, 1909) from Subantarctic Water off Otago Peninsula. Photo: Rob Murdoch, NIWA Oceanographic (NZOI).

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The Marine Fauna of New Zealand: Chaetognatha (Arrow Worms)

by

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CONTENTS

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ABSTRACT

The distribution and taxonomy of Chaetognatha from the New Zealand region of the Southwest Pacific is recorded on the basis of N.Z. Oceanographic Institute (NZOI) samples and published records. Some of the samples included specimens from Fiji, Tonga, and the Ross Sea — these records are also included in this account. In decreasing order of numerical abundance in the NZOI samples, the 19 species recorded (totalling 5865 individuals) are : *Serratosagitta tasmanica, Mesosagitta minima, Serratosagitta serratodentata, Eukrohnia hamata, Pseudosagitta lyra, Sagitta bipunctata, Flaccisagitta enflata, Pterosagitta draco, Pseudosagitta gazellae, Ferosagitta robusta, Pseudosagitta maxima, Solidosagitta zetesios, Mesosagitta decipiens, Krohnitta subtilis, Flaccisagitta hexaptera, Solidosagitta marri* (Ross Sea only), *Aidanosagitta regularis, Serratosagitta pacifica, and Aidanosagitta neglecta.*

All of these species are described and illustrated and new distributional records mapped. A key to the genera is provided. Species diversity in relation to the oceanic circulation around New Zealand is also discussed.

Keywords: Chaetognatha, arrow worms, New Zealand, Southwest Pacific, Tonga, Fiji, Antarctica, marine fauna, biodiversity, biogeography, *Pterosagitta, Krohnitta, Aidanosagitta, Ferosagitta, Flaccisagitta, Pseudosagitta, Mesosagitta, Sagitta, Serratosagitta, Solidosagitta, Eukrohnia.*

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INTRODUCTION

The distribution of Chaetognatha in the New Zealand region has not previously been examined in its entirety. Existing knowledge is based mainly on expedition reports, studies on particular species, or plankton studies in general (Kent 1870; Parker 1895; Fowler 1908; Ritter-Záhony 1909; Benham 1912; Burfield 1930). The adjacent Australian chaetognath fauna has been described by Whitelegge (1889), Waite (1899), Johnston (1909), Ritter-Záhony (1909, 1910, 1911), Johnston and Taylor (1919, 1921), Tokioka (1940), Dakin and Colefax (1940), Thomson (1947), and Taw (1978). Comprehensive studies of the Pacific fauna have been published by Bieri (1959) and Alvariño (1964), the Southern Ocean* fauna by O'Sullivan (1982), and the worldwide distribution of chaetognaths by Alvariño (1965).

This study records species from 133 stations in the New Zealand region from subtropical to subantarctic waters. Three NZOI samples from Fiji, Tonga, and the Ross Sea respectively, are also included in the study.

Chaetognaths are exclusively marine planktonic predators. The essential features of the chaetognath body are shown in Figure 1. The body is usually stiff and turgid but some species are more or less flaccid. Rigidity is a useful characteristic but difficult to determine, being affected by the size of the worm and preservation. Fraser (1952) remarks that, roughly speaking, a specimen that does not droop down on either side when picked up in the middle with a pair of forceps is 'rigid'; if it does it is 'flaccid'. There is relatively little anatomical variation in the group and the quality of preservation can affect taxonomically important characters. As a consequence, there is no consensus on the exact number of species and many species and even genera have uncertain status (Bieri 1991).

The arrow- or torpedo-shaped body is divided into three regions by internal partitions — head, trunk, and tail. Long, curved chitinous hooks project from each side of the head. In life these are used for seizing prey, together with several rows of much shorter spines (anterior and posterior teeth) that are curved around the front of the head. Dorsally, two small eyes are usually visible. Posterior to these, on the head and/or anterior part of the trunk, is a ciliary loop or corona ciliata — an oval or sinuous band of ciliated cells. This band is frequently difficult to see in preserved specimens and is thus not routinely illustrated in this memoir. In the neck region is a fold of body wall (the hood) that can be pulled forward to enclose the entire head, presumably to protect the hooks when they are not in use and to reduce water resistance whilst swimming. Ventrally on the head is the mouth, in a vestibular chamber, with an adjacent vestibular organ (papillate ridge) and vestibular pit on each side. From the mouth, a short oesophagus passes through the head/trunk septum to the intestine. Where they join, lateral intestinal diverticula may occur. The primary body-wall musculature is arranged generally in four longitudinal bands and, in some species, in a thin transverse layer as well.

A characteristic feature of chaetognaths is the 1–2 pairs of lateral fins with ray-like supports. The fins are very thin and easily damaged. The epidermis consists of two layers over most parts of the body. In some species, it is thickened in the neck region with a layer of large bladdery cells. This layer, called a collarette, can give a foamy appearance (O'Sullivan 1982). It can extend for some distance along the trunk, even merging with the lateral fins as in *Pterosagitta draco*, for example. Fine bristles and ciliated tufts occur along the trunk at intervals. The bristles, including the two large 'wing-like' tufts (hair-fans) in *Pterosagitta draco*, tend to drop off in fixed material. Inside the trunk is the large ventral ganglion, and a simple digestive tract exiting on the ventral surface at the trunk/tail septum. On each side of the intestine at its posterior end are the ovaries, which open laterally near the tail septum. The male reproductive structures occur in the tail segment. Sperm are released through the seminal vesicles which are situated laterally between the tail and lateral fins, forming bulges of varying shapes. The tail ends in a horizontal fin. Chaetognaths are hermaphrodites with direct development — there is no larva *per se*.

Identification to species is, of necessity, based on combinations of characters. In well-preserved mature specimens the position and shape of the seminal vesicles is characteristic, but unfortunately mature specimens are rarely caught in New Zealand waters.

* The term "Southern Ocean" was introduced by David (1958) and stands for all oceans which are situated between the Subtropical Convergence and the Antarctic Continent.

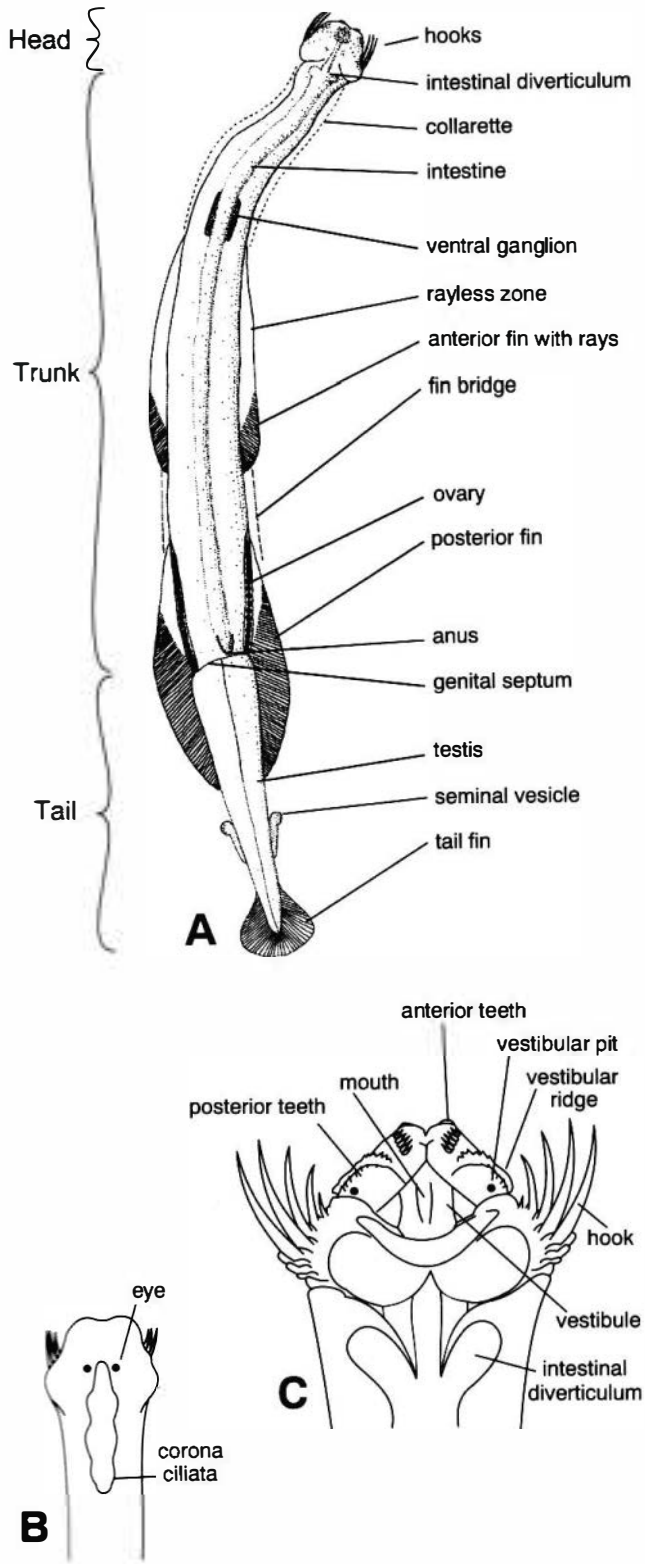


Fig. 1. A. Composite immature chaetognath (dorsal view). B. Anterior end (dorsal view). C. Head (ventral view). [B and C simplified after Hyman (1959) and Pierrot-Bults & Chidgey (1988).]

Artificial key to the genera discussed in this memoir (based on NZOI material)

1. Two pairs of lateral fins — 4
   One pair of lateral fins — 2

2. Two rows of teeth, lateral fins entirely on the tail segment, collarette thick — *Pterosagitta*
   One row of teeth, lateral fins straddle trunk and tail segments, no collarette — 3

3. Lateral fins broad, > half their length on the tail segment, distant from ventral ganglion, teeth long — *Krohnitta*
   Lateral fins long, mostly on the trunk segment, beginning near ventral ganglion, teeth short — *Eukrohnia*

4. Intestinal diverticula present — 5
   Intestinal diverticula absent — 8

5. Intestinal diverticula prominent — *Solidosagitta*
   Intestinal diverticula small — 6

6. Collarette present — 7
   Collarette absent — *Mesosagitta*

7. Both pairs of fins entirely rayed, head not wider than trunk width — *Aidanosagitta*
   Posterior fins with a narrow rayless zone, head wider than trunk width — *Ferosagitta*

8. Body rigid, collarette present — 9
   Body flaccid, collarette absent — 10

9. Collarette moderate, hooks not serrated — *Sagitta*
   Collarette very thin, hooks obviously serrated — *Serratosagitta*

10. Fins very close or a bridge between anterior and posterior fins, body moderately flaccid — *Pseudosagitta*
    Fin bridge lacking, body very flaccid — *Flaccisagitta*

Other characters therefore include hook and teeth formulae, presence/absence of collarette, intestinal diverticula, and fin rays, the relative proportions of the body segments, and fin position and shape. Eye pigmentation can be a useful identifying characteristic in chaetognaths. It must be noted, however, that the shape made by this pigment can vary within a species, so this character should be used with caution. The key uses these non-reproductive characters in order that immature specimens may be more readily identified.

MATERIALS AND METHODS

The material used in this study was made available to the author by the New Zealand Oceanographic Institute. Most samples were collected in the years 1956–59, 1966–68 and 1973–74, in the course of which various combinations of sampling gear were used for horizontal, vertical, and oblique hauls (Table 1). Details of the gear used at stations and explanations of annotations following the station data are given in Table 2.

The chaetognaths from the stations prefixed by "N" were preserved in 4% formaldehyde. In worse condition are specimens from the remaining samples which were kept in 70% alcohol. Both formaldehyde and alcohol cause shrinkage and alteration of body proportions (Repelin & Gueredrat 1970; Furnestin 1976; Conway & Robins 1991). For that reason the average body length was always calculated separately for alcohol- and formaldehyde-preserved specimens. Body length was measured with the help of a stereomicroscope and graph paper, and taken as the distance from the front of the head to the tip of the tail, excluding the tail fin.

Determination of the species was carried out using a light microscope. Some specimens were stained with borax carmine and blue de Lyon following Romeis (1968). Drawings were made using a camera lucida. All the illustrations of species are depicted in dorsal view.

Maturity stages

Chaetognaths are protandrous hermaphrodites but protandry is not developed to the same degree in all species (Thomson 1947). If, for every maturity stage, the stage of development of both testes and ovaries is given (e.g., Kramp 1917; Russell 1932; Pierce 1951; David 1955), it would be necessary to define different maturity stages for every species as Kramp (1939) did, which restricts easy comparison among the species. Accordingly, in this work only the ovaries are used to define the maturity stages as Thomson (1947) did.

0 = female gonads not visible in light microscope
1 = female gonads are being formed, no ova differentiated
2 = ova are present, small and immature
3 = ovaries have reached their total length, some ova are fully developed
4 = all ova are mature, or the ovaries are already evacuated.

Synonymy

The synonyms which are quoted for individual species have been taken from the following papers:

1 = Tokioka 1965
2 = Pierrot-Bults and Chidgey 1988
3 = Ritter-Záhony 1911
4 = Kassatkina 1982
5 = Thomson 1947.

LIST OF STATIONS

TABLE 1. New Zealand Oceanographic Institute station data.
(Surf. = surface; H = horizontal; V = vertical; O = oblique)

Stn. No.	Date	Latitude (°S)	Longitude	Depth (m)	Depth of haul (m)	Gear (see Table 2)	Type of tow
A305	11.6.56	37°32'	179°50'E	3142	Surf.	L50	H
A306	19.6.56	38°50'	178°59'W	3515	Surf.	L50	H
A307	20.6.56	42°55'	177°26'W	640	Surf.	L50	H
A308	22.6.56	42°35'	179°58'W	1586	Surf.	L50	H
A309	28.6.56	44°17'	174°52'E	565	500–0	N70	V
A310	29.6.56	47°26'	175°07'E	1160	Surf.	L50	H
A311	31.6.56	47°57'	168°10'E	143	125–0	N70	O
A313	17.8.56	46°46'	164°35'E	4676	Surf.	L50	H
					500–0	N70	V
A314	18.8.56	42°30'	162°40'E	4883	Surf.	L50	H
A315	19.8.56	39°46'	167°45'E	1147	Surf.	L50	H
A332	1.2.57	41°41'	167°03'E	2195	Surf.	N70	H
A454	14.1.59	75°56'	176°30'W	895	700–0	N70	V
A455	15.1.59	74°22'	178°35'W	314	300–0	N70	V
B27	28.12.56	64°54'	178°10'E	3050	Surf.	N50	H
B28	29.12.56	65°50'	172°00'E	2017	Surf.	N50	H
B31	31.12.56	57°47'	169°06'E	5276	Surf.	N50	H
B33	1.5.57	52°00'	167°30'E	748	10–0	N50	H
B64	2.9.58	34°54'	177°05'E	2313	Surf.	N70	H
B65	3.9.58	32°51'	179°10'E	2955	Surf.	N70	H
B66	3.9.58	32°06'	179°57'E	3328	Surf.	N70	H
					Surf.	N50	H
B67	4.9.58	30°06'	179°16'W	1946	Surf.	N70	H
B78	12.9.58	18°49'	171°38'W	5377	Surf.	N70	H
B87	16.9.58	Suva Wharf, Fiji		0	Surf.	N70	H
B99	25.11.58	54°05'	160°26'E	2400	Surf.	N70	H
B106	27.11.58	55°42.50'	165°23'E	4663	Surf.	N70	H
B107	28.11.58	58°19'	167°18'E	4938	Surf.	N70	H
B109	1.12.58	62°37'	169°51'E	2886	Surf.	N15	H
B110	1.12.58	61°55.50'	170°26'E	4528	125–0	N15	V
B111	2.12.58	61°25.50'	170°41'E	1092	500–0	N15	V
B112	2.12.58	60°47'	170°44'E	4389	125–0	N15	V
B113	2.12.58	60°22'	170°54'E	4810	125–0	N15	V
B114	2.12.58	59°39'	171°02'E	5121	125–0	N15	V
B116	3.12.58	58°20'	171°14'E	5230	125–0	N15	V
B117	4.12.58	57°11'	171°05'E	3780	500–0	N15	V
B119	4.12.58	54°31'	170°20'E	1500	500–0	N15	V
B120	5.12.58	53°26.30'	170°15'E	510	500–0	N15	V
					150–0	N15	V
B174	8.10.59	49°15'	167°36.80'E	799	Surf.	N70	H
B189	14.10.59	52°33.18'	169°07.75'	29	29–0	N70	V
E709	21.3.67	40°28'	177°43'E	1642	1600–0	N70	V

Stn. No.	Date	Latitude (°S)	Longitude	Depth (m)	Depth of haul (m)	Gear (see Table 2)	Type of tow
E761	31.3.67	42°44'	173°45.30'E	852–863		MT	
E762	31.3.67	42°44'	173°47.20'E	1015–1048		MT	
E774	15.10.67	42°00'	169°15'E	1161		MT	
F753	18.8.66	44°45'	174°30'E	763–854		MT	
N333	3.12.74	40°30.25'	176°38'E	38	30–0	WP2	V
N334	3.12.74	40°31.20'	176°39.05'E	55	50–0	WP2	V
N335	3.12.74	40°32.85'	176°41.80'E	100	100–0	WP2	V
N336	3.12.74	40°36.40'	176°47.90'E	200	200–0	WP2	V
N337	3.12.74	40°42.70'	176°58.30'E	500	200–0	WP2	V
N338	4.12.74	39°11.80'	177°13.60'E	25	25–0	WP2	V
N339	4.12.74	39°15'	177°18'E	50	50–0	WP2	V
N340	4.12.74	39°25.80'	177°30.60'E	100	100–0	WP2	V
N341	4.12.74	39°37.80'	177°43.90'E	204	200–0	WP2	V
N342	4.12.74	39°45'	177°54.60'E	500	200–0	WP2	V
N344	5.12.74	37°44.50'	178°35.50'E	51	50–0	WP2	V
N345	5.12.74	37°43.70'	178°41.70'E	101	100–0	WP2	V
N346	5.12.74	37°44.20'	178°49.40'E	211	200–0	WP2	V
N347	5.12.74	37°44.20'	178°01.40'E	500	200–0	WP2	V
N349	6.12.74	37°45.70'	176°40.60'E	51	50–0	WP2	V
N350	6.12.74	37°40.80'	176°44'E	101	100–0	WP2	V
N351	6.12.74	37°38.70'	176°45.60'E	207	200–0	WP2	V
N352	6.12.74	37°30'	176°50.70'E	500	200–0	WP2	V
N353	6.12.74	37°21.30'	176°58'E	500	200–0	WP2	V
N355	7.12.74	36°44'	175°20.10'E	38	40–0	WP2	V
N356	7.12.74	36°31.30'	175°17.60'E	50	50–0	WP2	V
N357	7.12.74	35°58.90'	175°20.90'E	104	100–0	WP2	V
N358	7.12.74	35°49.80'	175°34.50'E	200	200–0	WP2	V
N359	7.12.74	35°44.10'	175°44.20'E	184	180–0	WP2	V
N360	8.12.74	35°13.60'	174°06.40'E	24	24–0	WP2	V
N361	8.12.74	35°11'	174°10.35'E	51	50–0	WP2	V
N364	8.12.74	34°56.50'	174°31.40'E	500	200–0	WP2	V
N365	8.12.74	35°07.40'	174°16.40'E	200	200–0	WP2	V
N370	10.12.74	34°23.50'	172°06'E	204	200–0	WP2	V
N371	10.12.74	34°23.40'	171°54.50'E	3807	200–0	WP2	V
N372	11.12.74	36°19.50'	173°58.80'E	25	25–0	WP2	V
N373	11.12.74	36°20.10'	173°56.10'E	51	50–0	WP2	V
N374	11.12.74	36°20.10'	173°50.45'E	100	100–0	WP2	V
N375	11.12.74	36°23.60'	173°45.50'E	200	200–0	WP2	V
N376	11.12.74	36°28.90'	173°34'E	500	200–0	WP2	V
N378	12.12.74	37°48.90'	174°39.40'	50	50–0	WP2	V
N379	12.12.74	37°48.90'	174°13.20'E	100	100–0	WP2	V
N380	12.12.74	37°48.70'	174°04.90'E	200	200–0	WP2	V
N381	12.12.74	37°48.40'	173°49'E	500	200–0	WP2	V
N382	13.12.74	39°15'	173°43.40'E	25	25–0	WP2	V
N383	13.12.74	39°15.70'	173°42.60'E	50	50–0	WP2	V
N384	13.12.74	39°15.90'	173°39.40'E	100	100–0	WP2	V
N385	13.12.74	39°14.90'	172°22.30'E	200	200–0	WP2	V
N386	13.12.74	39°14.90'	171°56.40'E	505	200–0	WP2	V
N387	14.12.74	40°28.80'	173°30.20'E	73	70–0	WP2	V
N388	14.12.74	40°44.30'	173°22.80'E	55	50–0	WP2	V

Stn. No.	Date	Latitude (°S)	Longitude	Depth (m)	Depth of haul (m)	Gear (see Table 2)	Type of tow
N389	14.12.74	40°53.20'	173°19'E	47	50-0	WP2	V
N385	15.12.74	40°58.20'	173°58.40'E	62	60–0	WP2	V
N396	15.12.74	40°55.80'	174°03.50'E	100	100-0	WP2	V
N397	15.12.74	40°55.10'	174°08.40'E	40	40-0	WP2	V
N398	15.12.74	40°49.50'	174°16'E	100	100-0	WP2	V
N399	16.12.74	40°27.30'	175°11.20'E	25	25–0	WP2	V
N400	16.12.74	40°26.80'	175°09.20'E	53	50-0	WP2	V
N401	16.12.74	40°24'	174°52'E	100	100–0	WP2	V
N402	16.12.74	40°17.60'	174°13.60'E	103	100-1	WP2	V
N404	17.12.74	41°38'	175°18.80'E	51	20-0	WP2	V
N405	17.12.74	41°38.50'	175°19.30'E	100	50-0	WP2	V
N406	17.12.74	41°39.20'	175°20.20'E	200	200–0	WP2	V
N407	17.12.74	41°44'	175°22.90'E	500	200-0	WP2	V
N408	17.12.74	41°48.60'	175°24.40'E	500	200-0	WP2	V
N411	18.12.74	42°28'	173°43'E	100	100-0	WP2	V
N412	18.12.74	42°29.20'	173°45.20'E	190	190-0	WP2	V
N413	18.12.74	42°32.50'S	173°49.90'E	500	200-0	WP2	V
N414	18.12.74	42°35.40'	173°55'E	500	200-0	WP2	V
N415	18.12.74	42°39'	173°59.80'E	500	200-0	WP2	V
N416	19.12.74	41°18.85'	174°09.60'E	22	22-0	WP2	V
N418	19.12.74	41°41.84'	174°17.80'E	51	50–0	WP2	V
N419	19.12.74	41°35.20'	174°28'E	99	90–0	WP2	V
N420	19.12.74	41°29.20'	174°383.20'E	191	190-0	WP2	V
N421	19.12.74	41°24.40'	174°45'E	100	100-0	WP2	V
N422	19.12.74	41°22.80'	174°46.60'E	50	50-0	WP2	V
N423	19.12.74	41°21.50'	174°49.50'E	25	25–0	WP2	V
N428	29.1.75	40°41.80'	172°20'E	27	25–0	WP2	V
N429	29.1.75	40°40.19'	172°17.70'E	50	50-0	WP2	V
N430	29.1.75	40°34.70'	172°11.60'E	100	100–0	WP2	V
N431	29.1.75	40°23.80'	171°59.30'E	200	200–0	WP2	V
N432	29.1.75	40°11'	171°44.80'E	356	200-0	WP2	V
N434	30.1.75	41°45.40'	171°24.50'E	56	50-0	WP2	V
N435	30.1.75	41°43.60'	171°20.70'E	111	110-0	WP2	V
N436	30.1.75	41°34'	170°57.90'E	201	200–0	WP2	V
N438	30.1.75	41°16.10'	170°18'E	715	200–0	WP2	V
N440	31.1.75	43°19.80'	169°55.10'E	51	50-0	WP2	V
N441	31.1.75	43°18.30'	169°52.60'E	100	100-0	WP2	V
N442	31.1.75	43°13.90'	169°47.30'E	200	200-0	WP2	V
N445	1.2.75	44°39.60'	167°54.70'E	176	176-0	WP2	V
N446	1.2.75	44°37.20'	167°52.60'E	290	200-0	WP2	V
N447	1.2.75	44°31.50'	167°48.90'E	135	120–0	WP2	V
N448	1.2.75	44°31.90'	167°44.10'E	83	80-0	WP2	V
N449	1.2.75	44°28.90'	167°38.60'E	1750	200-0	WP2	V
N450	1.2.75	44°22.80'	167°28.60'E	3500	200–0	WP2	V
N453	2.2.75	46°00.80'	166°36.40'E	351	200–0	WP2	V
N454	2.2.75	46°04'	166°34.50'E	120	70-0	WP2	V
N456	3.2.75	46°04.01'	166°17.20'E	172	170–0	WP2	V
N457	3.2.75	46°03.80'	166°02.80'E	176	170–0	WP2	V
N458	3.2.75	46°05.40'	165°49.80'E	1663	200–0	WP2	V
N459	4.2.75	46°41.40'	167°55.40'E	44	40-0	WP2	V

Stn. No.	Date	Latitude (°S)	Longitude	Depth (m)	Depth of haul (m)	Gear (see Table 2)	Type of tow
N460	4.2.75	46°36.80'	167°58.80'E	38	38–0	WP2	V
N461	4.2.75	46°32'	168°02'E	36	36–0	WP2	V
N462	4.2.75	46°27.70'	168°04.20'E	28	28–0	WP2	V
N463	5.2.75	48°16'	166°22.80'E	160	160–0	WP2	V
N464	5.2.75	47°52.10'S	166°43.40'E	160	160–0	WP2	V
N466	5.2.75	47°30.50'S	167°15.70'E	152	150–0	WP2	V
N467	5.2.75	47°18.70'	167°30.90'E	96	90–0	WP2	V
N469	6.2.75	46°25.10'	169°57.80'E	57	55–0	WP2	V
N471	6.2.75	46°30.90'	170°14.60'E	255	200–0	WP2	V
N472	6.2.75	46°06.50'	171°09'E	25	25–0	WP2	V
N473	6.2.75	45°08.80'	171°14.40'E	50	50–0	WP2	V
N474	7.2.75	45°12.20'	171°22.60'E	100	100–0	WP2	V
N475	7.2.75	45°15.70'	171°39.20'E	200	50–0	WP2	V
N480	8.2.75	43°33.20'	173°48.70'E	100	100–0	WP2	V
N481	8.2.75	43°33.80'	173°59.80'E	200	200–0	WP2	V
N482	8.2.75	43°35.80'	174°21.60'E	310	200–0	WP2	V

TABLE 2. Details of Gear Used at Stations

Symbol	Net	Mesh Aperture (μm)	Diameter (m)	Source
L50	Discovery N50 net	240	0.5	Bary (1956)
N15	—	240	0.15	—
N50	Discovery N50 net	53	0.5	Kemp and Hardy (1929)
N70	Discovery N70 net	240	0.7	Kemp and Hardy (1929)
MT	Modified Menzies Trawl	1200	0.15	Menzies (1962)
WP2	[Designed by Working Party 2, modified for free-falling]	200	0.57	Fraser (1962, 1968) Heron (1982)

LIST OF SPECIES

Nineteen species of the phylum Chaetognatha were found in the NZOI samples. These belong to two orders and four families according to the schemes of Salvini-Plawen (1986) and Bieri (1991).

Order APHRAGMOPHORA
Family PTEROSAGITTIDAE
Genus ***Pterosagitta***
Pterosagitta draco (Krohn)

Family KROHNITTIDAE
Genus ***Krohnitta***
Krohnitta subtilis (Grassi)

Family SAGITTIDAE
Genus ***Aidanosagitta***
Aidanosagitta neglecta (Aida)
Aidanosagitta regularis (Aida)

Genus ***Ferosagitta***
Ferosagitta robusta (Doncaster)

Genus ***Flaccisagitta***
Flaccisagitta hexaptera (d'Orbigny)
Flaccisagitta enflata (Grassi)

Genus ***Pseudosagitta***
Pseudosagitta lyra (Krohn)
Pseudosagitta gazellae (Ritter-Záhony)
Pseudosagitta maxima (Conant)

Genus ***Mesosagitta***
Mesosagitta minima (Grassi)
Mesosagitta decipiens (Fowler)

Genus ***Sagitta***
Sagitta bipunctata Quoy & Gaimard

Genus ***Serratosagitta***
Serratosagitta pacifica (Tokioka)
Serratosagitta serratodentata (Krohn)
Serratosagitta tasmanica (Thomson)

Genus ***Solidosagitta***
Solidosagitta marri (David)
Solidosagitta zetesios (Fowler)

Order PHRAGMOPHORA
Family EUKROHNIIDAE
Genus ***Eukrohnia***
Eukrohnia hamata (Möbius)

Altogether 5865 chaetognaths were identified. Nearly half of the individuals belonged to *Serratosagitta tasmanica* (Table 3). Probably because of the capture method, no benthic spadellids were found. Since they are known to occur off New South Wales (Mawson 1944) and Antarctica (Casanova 1991) it is likely they will be found in New Zealand waters.

TABLE 3.

Species composition and abundance in the N.Z. Oceanographic Institute samples.

Species	Frequency (%)	No. of specimens
Serratosagitta tasmanica	48.92	2869
Mesosagitta minima	18.52	1086
Serratosagitta serratodentata	7.69	451
Eukrohnia hamata	6.87	403
Pseudosagitta lyra	3.47	203
Sagitta bipunctata	3.44	202
Flaccisagitta enflata	2.93	172
Pterosagitta draco	2.51	147
Pseudosagitta gazellae	1.82	107
Ferosagitta robusta	1.11	65
Pseudosagitta maxima	0.80	47
Solidosagitta zetesios	0.55	32
Mesosagitta decipiens	0.46	27
Krohnitta subtilis	0.41	24
Flaccisagitta hexaptera	0.37	22
Solidosagitta marri	0.05	3
Aidanosagitta regularis	0.03	2
Serratosagitta pacifica	0.03	2
Aidanosagitta neglecta	0.02	1

SYSTEMATICS

Family PTEROSAGITTIDAE Tokioka, 1965

Only one pair of lateral fins, beginning at the trunk-tail septum. Two rows of teeth. Massive collarette extending from the neck nearly to the seminal vesicles. Lateral bristles at the level of the ventral ganglion (seen only in well-preserved specimens).

Pterosagitta Costa, 1869

Corona ciliata longer than wide, and extending below the level of the neck. Lateral fins completely rayed.

REMARKS: The genus *Pterosagitta* contains only one, widely distributed species which has also been taken in the Southwest Pacific.

Pterosagitta draco (Krohn, 1853) (Fig. 2)

Sagitta draco Krohn, 1853.
Pterosagitta mediterranea Costa, 1869.[2]
Spadella draco : Langerhans 1880.[1]
Spadella vougai Béraneck, 1895.[1]
Dracochaetus Krohni Abric, 1905.[1]
Pterosagitta draco: Ritter-Záhony 1910.
Pterosagitta lesnardi Vanucci & Hosoe, 1952.[1]

DESCRIPTION: Size up to 16.0 mm. *Tail* 38-40% of total body length (Pierrot-Bults & Chidgey 1988). *Lateral fins* triangular shaped. "Wing-like" tufts of bristles (hair-fans) occur about mid-body. *Hooks* 8–10, *anterior teeth* 6–10, *posterior teeth* 8–18 (Pierrot-Bults & Chidgey 1988). *Eyes* round with T-shaped pigment-spot (Fig. 2B). *Intestinal diverticula* absent. Mature *ovaries* extend to the neck region. Ova large. *Seminal vesicles* a little remote from caudal fin, contacting lateral fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930; Jillett 1971). Off south-eastern Australia and Tasmania (Dakin & Colefax 1940; Tokioka 1940; Thomson 1947; Taw 1978).

DISTRIBUTION: An epiplanktonic cosmopolitan species of warm-temperate seas (Alvariño 1965).

NEW RECORDS: *Pterosagitta draco* occurred at 28 NZOI stations (Appendix 2), between 30°06'S and 47°30.50'S (Map 1). Southwards, the distribution is limited by the Subtropical Convergence.

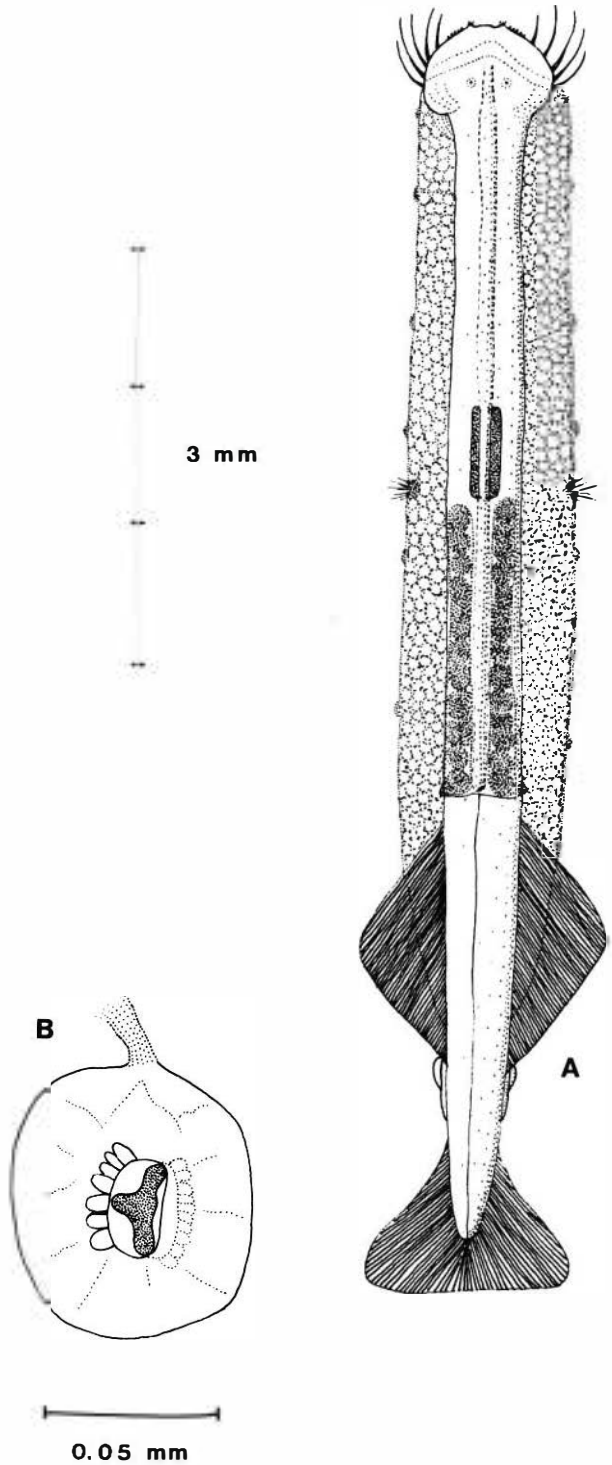
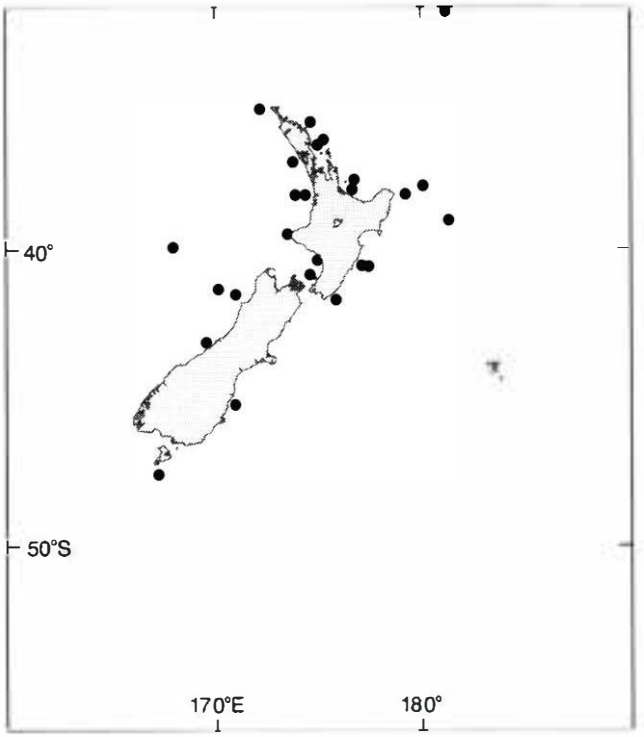


Fig. 2. A. *Pterosagitta draco* (maturity stage 2). B. Eye (right).

MATURITY STAGES: 40 of the 147 (27.2%) individuals of this species belonged to stage 0, 51 (34.7%) to stage 1, 24 (16.3%) to stage 2, and 32 (21.8%) to stage 3. The average body length relating to the maturity stages and the preservation method is given in Appendix 1.



Map 1. New records of *Pterosagitta draco*.

Family KROHNITTIDAE Tokioka, 1965

Only one pair of broad lateral fins, beginning above the trunk-tail septum. One row of long and characteristically formed triangular-shaped teeth. Collarette and intestinal diverticula absent. Hooks are curved more abruptly than in representatives of the family Sagittidae.

Krohnitta Ritter-Záhony, 1910

Corona ciliata short, beginning at the level of the neck. Lateral fins with a distinct rayless zone.

REMARKS: The genus *Krohnitta* contains the following species: *K. pacifica* (Aida, 1897); *K. subtilis* (Grassi, 1881) (type species).

The following species have been taken in the Southwest Pacific:

Krohnitta subtilis (Grassi, 1881) (Fig. 3)

Sagitta subtilis Grassi, 1881.
Spadella subtilis : Grassi 1883.[3]
Krohnia subtilis: Strodtmann 1892.[2]
Krohnitta subtilis : Ritter-Záhony 1910.
Eukrohnia subtilis : Michael 1911.[2]

DESCRIPTION: Size up to 16.5 mm (Ritter-Záhony 1911). *Tail* 30-40% of total body length (Pierrot-Bults & Chidgey 1988). Two-thirds of the broad *lateral fins*, which are only marginally rayed, occur along the tail segment. *Hooks* 5–10 (Ritter-Záhony 1911); *teeth* 10–13 (Pierrot-Bults & Chidgey 1988). The *teeth* (Fig. 2C) consist of the basal plate, intermediate piece, and the tooth proper (Ritter-Záhony 1911). *Eyes* round with T-shaped pigment-spot (Fig. 3B). *Corona ciliata* attains approximately the head length and is shaped like a deltoid (Ritter-Záhony 1911). The short *ovaries* with few eggs do not reach beyond the lateral fins at full maturity. *Seminal vesicles* adjacent to lateral fins and caudal fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Off southeastern Australia and Tasmania (Tokioka 1940; Dakin & Colefax 1940; Thomson 1947).

DISTRIBUTION: An epiplanktonic cosmopolitan species of warm and temperate oceans (Alvariño 1965).

NEW RECORDS: *Krohnitta subtilis* occurred at six NZOI stations (Appendix 4) between 34°56.50'S and 40°42.70'S (Map 2). The southern limit of distribution is represented by the Subtropical Convergence.

MATURITY STAGES: One of the 24 (4.2%) individuals of the species belonged to stage 0, 3 (12.5%) to stage 1, 17 (70.8%) to stage 2, and 3 (12.5%) to stage 3. The average body length relating to the maturity stages and the preservation method is given in Appendix 3.

Family SAGITTIDAE Grobben *in* Claus & Grobben, 1905

Two pairs of lateral fins, the anterior one lying at the trunk, the posterior one partly at the trunk and at the tail. Two rows of teeth.

Aidanosagitta Tokioka & Pathansali, 1963

Lateral fins are wholly rayed, with the fin rays almost at right angles to the body wall. Corona ciliata

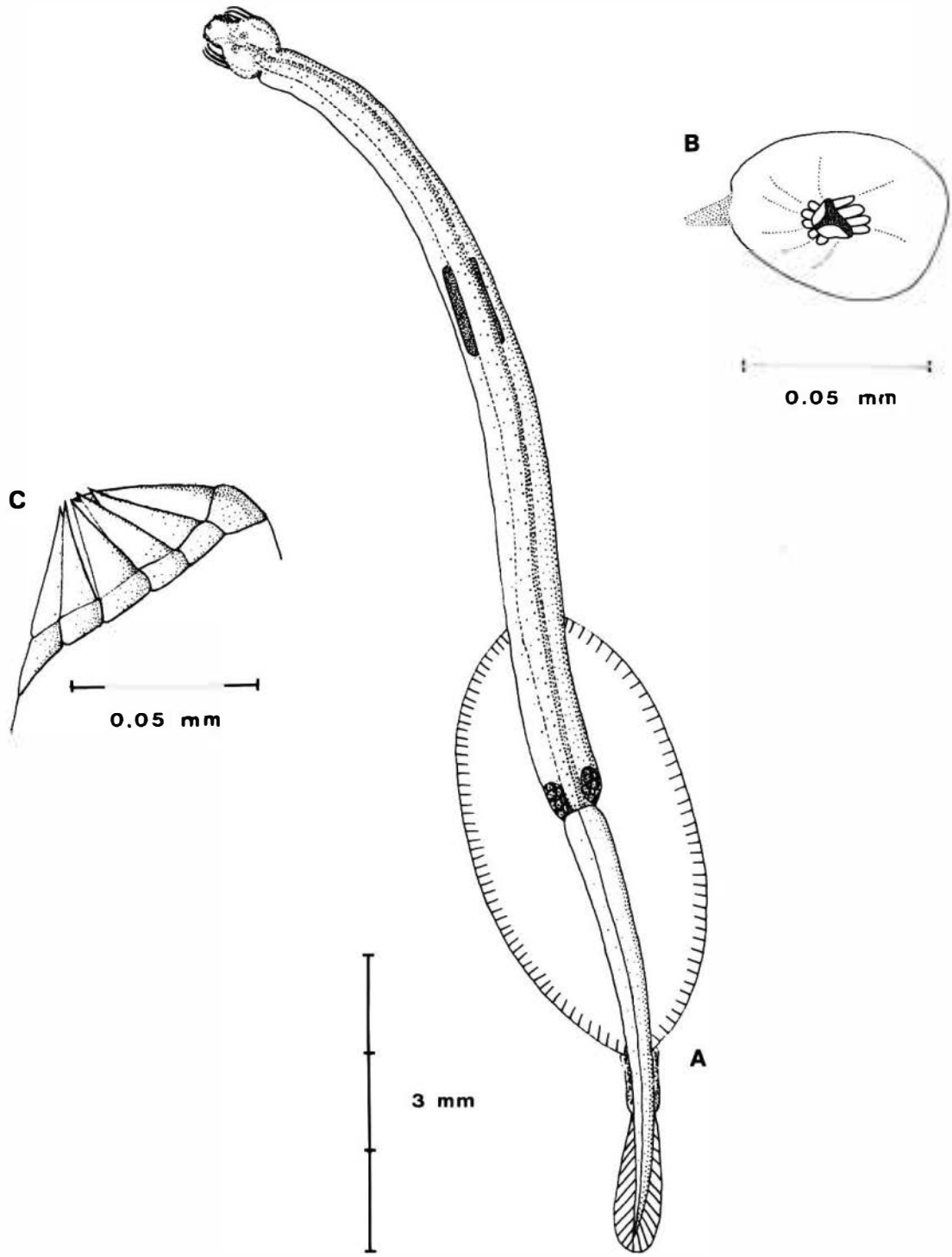
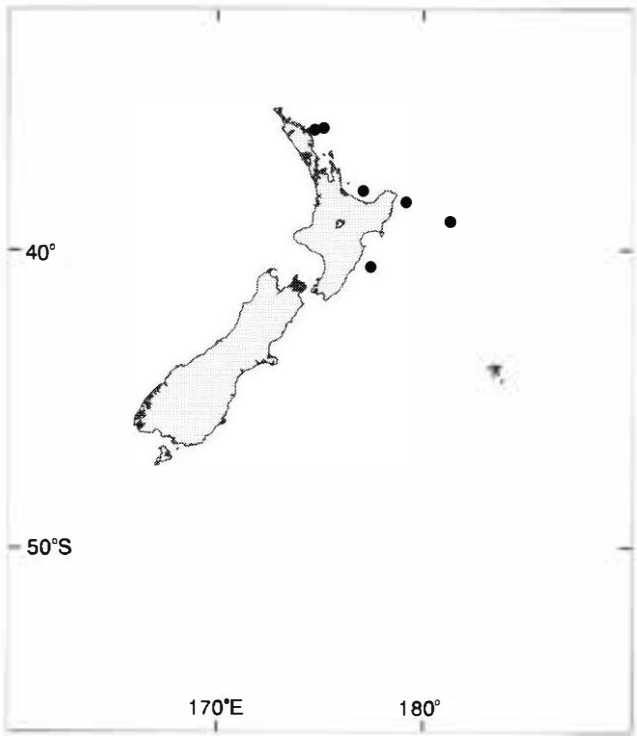


Fig. 3. **A.** *Krohnitta subtilis* (maturity stage 2). **B.** Eye (right). **C.** Teeth (right).



Map 2. New records of *Krohnitta subtilis*.

beginning below the level of the eyes. *Intestinal diverticula* are present.

REMARKS: The genus *Aidanosagitta* contains the following species:
A. bedfordii (Doncaster, 1902); *A. coreana* (Molchanov, 1907); *A. crassa* (Tokioka, 1938); *A. delicata* (Tokioka, 1939); *A. demipenna* (Tokioka & Pathansali, 1963); *A. firmula* Kassatkina, 1971; *A. golicovi* Kassatkina, 1971; *A. johorensis* (Pathansali & Tokioka, 1963); *A. macilenta* Kassatkina, 1971; *A. modica* Kassatkina, 1971; *A. neglecta* (Aida, 1897) (type species); *A. oceania* (Grey, 1930); *A. parva* (Oye, 1918); *A. regularis* (Aida, 1897); *A. scarlatovi* Kassatkina, 1971; *A. tropica* (Tokioka, 1942).

The following species have been taken in the Southwest Pacific:

Aidanosagitta neglecta (Aida, 1897) (Fig. 4)

Sagitta neglecta Aida, 1897.
Sagitta septata Doncaster, 1902.[1]
Sagitta trichodermis Oye, 1918.[1]
Aidanosagitta neglecta : Tokioka 1965.

DESCRIPTION: Size up to 10 mm (Ritter-Záhony 1911). *Tail* 27–31% of total body length (Sund 1959). Anterior *fins* beginning a little behind the ventral ganglion, the posterior ones are broader and the greater part of

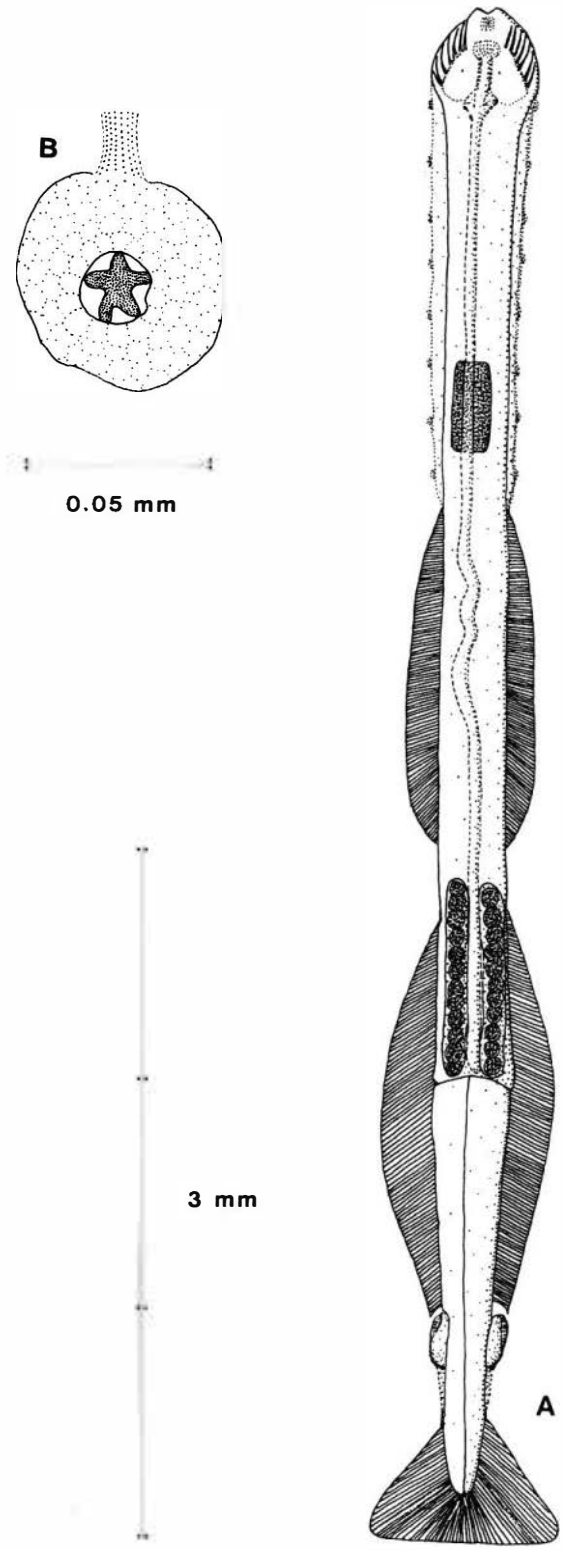


Fig. 4. A. *Aidanosagitta neglecta* (maturity stage 2). **B.** Eye (right).

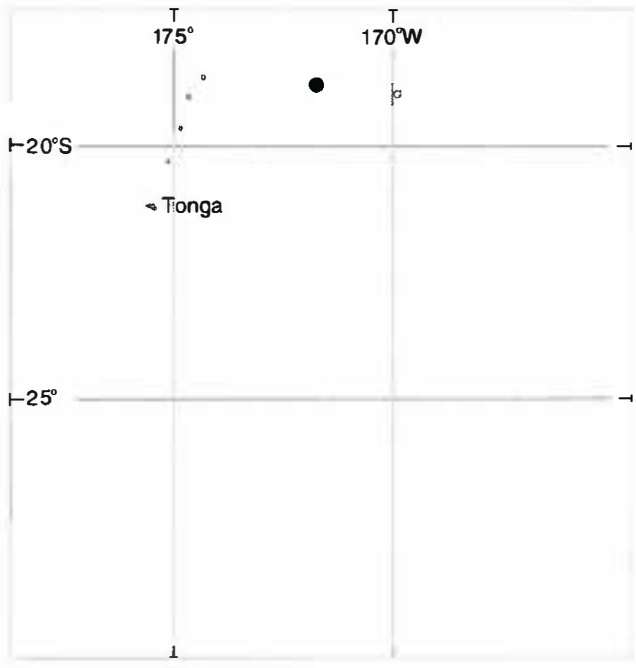
them is situated on the tail. *Hooks* 6–8; *anterior teeth* 5–7; *posterior teeth* 13–17 (Sund 1959). *Eyes* round with typical star-shaped pigment-spot (Fig. 4B). *Corona ciliata* reaches approximately double the head length and is indented four times (Ritter-Záhony 1911). *Collarette* extending from the head to the front of the anterior lateral fins and also existing in the region of the seminal vesicles. Mature *ovaries* reach occasionally beyond the ventral ganglion. *Seminal vesicles* nearly contact the lateral fins but are remote from the caudal fin.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off southeastern Australia and Tasmania (Johnston & Taylor 1919; Thomson 1947). Australian-Antarctic region (Johnston & Taylor 1921).

DISTRIBUTION: A tropico-equatorial Indo-Pacific species (Alvariño 1965).

NEW RECORDS: *Aidanosagitta neglecta* occurred at only one NZOI station (B78) (Appendix 5) at 18°49'S, 171°38'W (east of Tonga) (Map 3).

MATURITY STAGE: The single specimen which was preserved in 70% alcohol was 6 mm long and belonged to maturity stage 2.



Map 3. New station record for *Aidanosagitta neglecta, Ferosagitta robusta, Flaccisagitta enflata, Sagitta bipunctata, Serratosagitta pacifica,* and *S. serratodentata*

Aidanosagitta regularis (Aida, 1897) (Fig. 5)

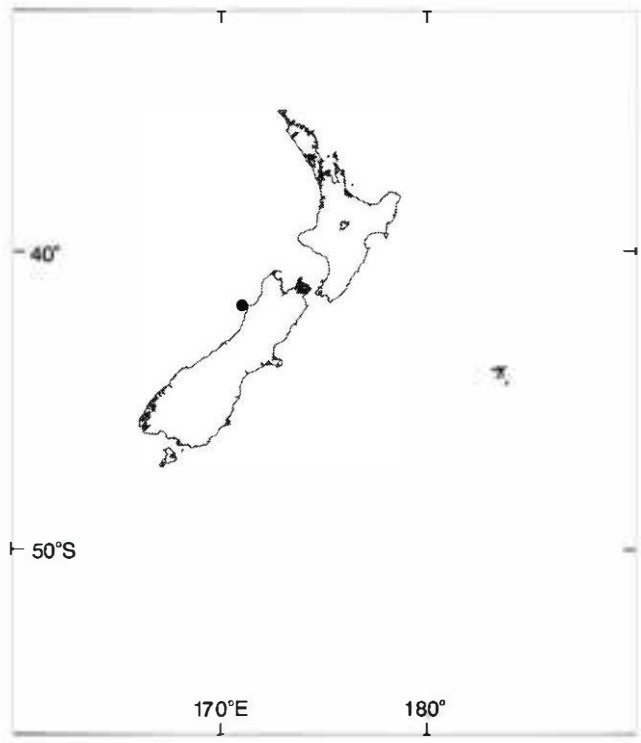
Sagitta regularis Aida, 1897.
Aidanosagitta regularis : Tokioka 1965.

DESCRIPTION: Size up to 9.5 mm. *Tail* 29–34% of the total body length (Sund 1959). Anterior lateral *fins* beginning a little behind the ventral ganglion; they are slightly shorter than those of *A. neglecta. Hooks* up to 9 (Ritter-Záhony 1911); *anterior teeth* 2–4; *posterior teeth* 4–7. Relatively big round *eyes* with narrow T-shaped pigment-spot (Fig. 5B). *Corona ciliata* lying entirely on the trunk; attaining approximately 1.5 times the head length and indented three times (Ritter-Záhony 1911). On the neck the *collarette* is strongly developed, occurring also on the remaining body. Mature *ovaries* reach the ventral ganglion. *Seminal vesicles* contacting the lateral fins but separated from the caudal fin.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off southeastern Australia and Tasmania (Thomson 1947).

DISTRIBUTION: An epiplanktonic tropico-equatorial Indo-Pacific species (Alvariño 1965).

NEW RECORDS: Two individuals of *A. regularis* occurred (Appendix 6) at 41°43.60'S and 171°20.70'E (Map 4).



Map 4. New record of *Aidanosagitta regularis.*

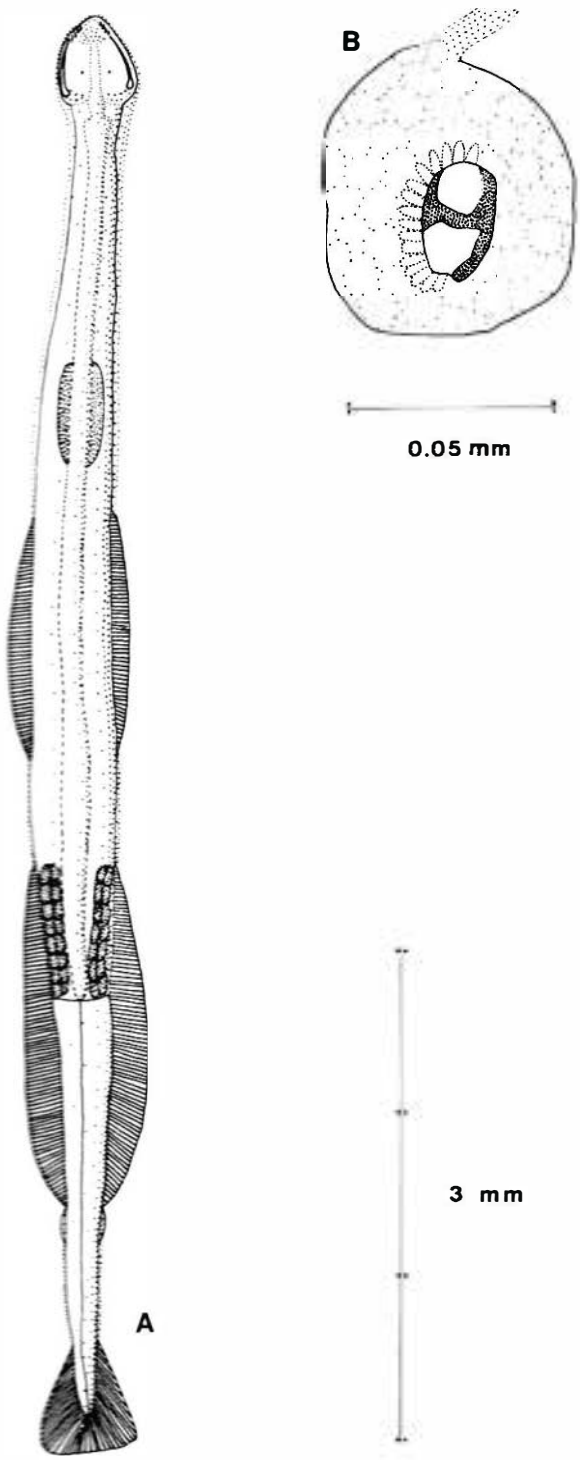


Fig. 5. **A.** *Aidanosagitta regularis* (maturity stage 2). **B.** Eye (right).

MATURITY STAGES: One was 9.5 mm long and belonged to stage 3, the other was 8 mm long and belonged to stage 2. Both were preserved in 4% formaldehyde.

Ferosagitta Kassatkina, 1971

Corona ciliata beginning beyond the eyes. Intestinal diverticula present.

REMARKS: The genus *Ferosagitta* contains the following species: *F. ferox* (Doncaster, 1902); *F. paulula* Kassatkina, 1971 (type species); *F. robusta* (Doncaster, 1902).

The following species has been taken in the Southwest Pacific.

Ferosagitta robusta (Doncaster, 1902) (Fig. 6)

Sagitta robusta Doncaster, 1902.
Sagitta ai Tokioka, 1939.[5]
Sagitta planctonis : Delsman 1939.[5]
Sagitta ferox f. *americana* Tokioka, 1959.[4]
Parasagitta robusta : Tokioka 1965.[4]
Sagitta ferox : Alvariño 1962.
Ferosagitta robusta : Kassatkina 1971.

DESCRIPTION: Size up to 22 mm (Thomson 1947). *Tail* 24–28% of total body length. *Anterior lateral fins* beginning at the posterior edge of the ventral ganglion. *Posterior lateral fins* with narrow rayless zone with the greater part situated on the tail. Characteristic broad head. *Hooks* 5–7; *anterior teeth* 6–11; *posterior teeth* 8–15 (Sund 1959). Big round *eyes* with T-shaped pigment-spot (Fig. 6B). *Corona ciliata* reaching nearly 2.5 times the head length (Ritter-Záhony 1911). *Collarette* extending from the neck to the front of the anterior lateral fins. Mature *ovaries* extend to the neck region. *Seminal vesicles* adjacent to lateral fins and caudal fin.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Off southeastern Australia and Tasmania (Johnston & Taylor 1919; Dakin & Colefax 1940; Tokioka 1940; Thomson 1947).

DISTRIBUTION: An epiplanktonic tropico-equatorial species (Alvariño 1965).

NEW RECORDS: At NZOI Stn B78, east of Tonga, 18°49'S, 171°38'W (Map 3) 65 individuals of the species were taken (Appendix 7).

MATURITY STAGES: 41 (63.1%) individuals belonged to stage 0, 21 (32.3%) to stage 1, and 3 (4.6%) to stage 2. All specimens were preserved in 70% alcohol.

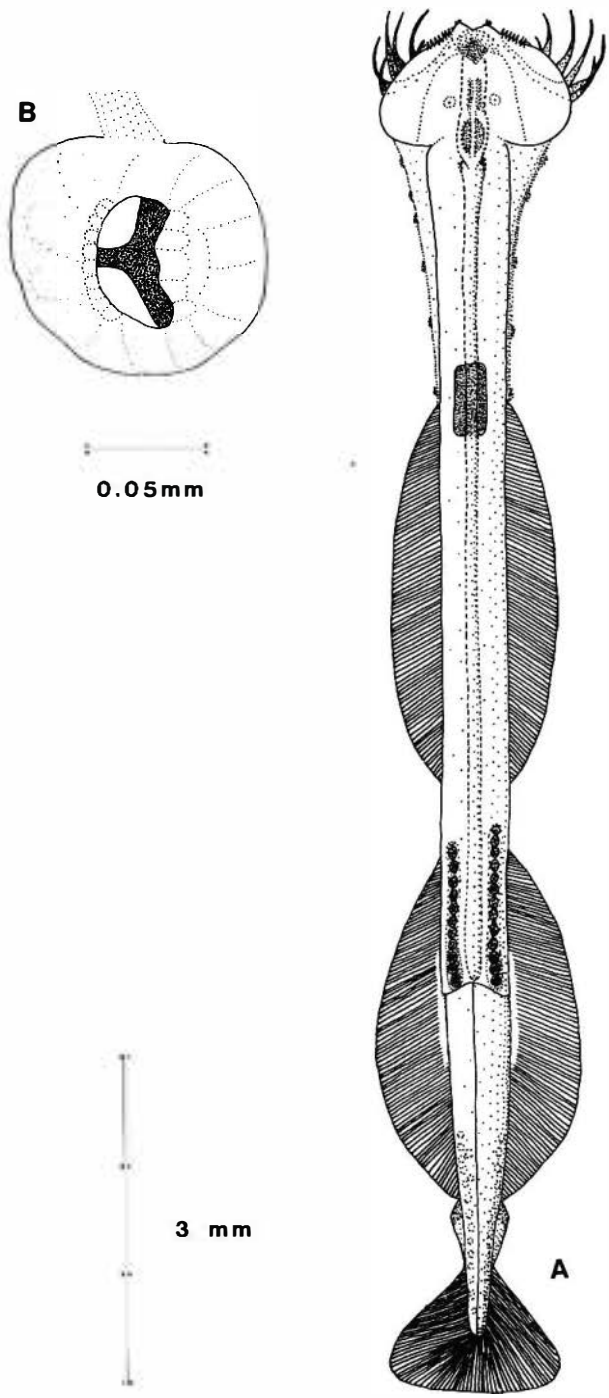


Fig. 6. A. *Ferosagitta robusta* (maturity stage 2). B. Eye (right).

Flaccisagitta Tokioka, 1965

Very flaccid body. Lateral fins showing distinctive rayless zones. Short corona ciliata confined to the head. Intestinal diverticula absent. Anterior fins are separate from posterior fins and some distance from ventral ganglion.

REMARKS: The genus *Flaccisagitta* contains the following species: *F. adenensis* (Casanova, 1985); *F. enflata* (Grassi, 1881); *F. hexaptera* (d'Orbigny, 1843) (type species).

The following species have been taken in the Southwest Pacific:

Flaccisagitta hexaptera (d'Orbigny, 1843) (Fig. 7)

Sagitta hexaptera d'Orbigny, 1843.
Sagitta exaptera d'Orbigny, 1843.[1]
Sagitta mediterranea Forbes, 1843.[1]
Sagitta tricuspidata Kent, 1870.[1]
Sagitta magna Langerhans, 1880.[1]
Sagitta longidentata Grassi, 1881.[1]
Sagitta darwini Grassi, 1883.[1]
Sagitta fowleri Benham, 1912.[1]
Sagitta hexaptera f. *magna* : Germain & Joubin 1916.[1]
Flaccisagitta hexaptera : Tokioka 1965.

DESCRIPTION: Size up to 70 mm. *Tail* 16–20% of total body length (Pierrot-Bults & Chidgey 1988). Small rounded *anterior lateral fins* well separated from the ventral ganglion; rays only on outer edge. Greater part of the *posterior lateral fins* situated on the trunk; an internal, anterior rayless zone. *Hooks* 6–10; *anterior teeth* 2–6 (long and dagger-shaped) (Fig. 6C); *posterior teeth* 3–8 (McLelland 1988). Small round *eyes* with T-shaped pigment spot (Fig. 7B). *Corona ciliata* pear-shaped (Ritter-Záhony 1911). *Collarette* absent. Mature *ovaries* sometimes extending to the neck region. Small, spherical *seminal vesicles* lying nearer to the caudal fin than to the lateral fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Kent 1870; Burfield 1930). Off south-eastern Australia and Tasmania (Tokioka 1940; Dakin & Colefax 1940; Thomson 1947; Taw 1978). Antarctic (Johnston & Taylor 1921). [David (1958) points out that this latter record may be explained by fin damage, causing *Pseudosagitta gazellae* to be confused with *F. hexaptera*.]

DISTRIBUTION: A cosmopolitan epiplanktonic species of temperate and warm seas (Alvariño 1965).

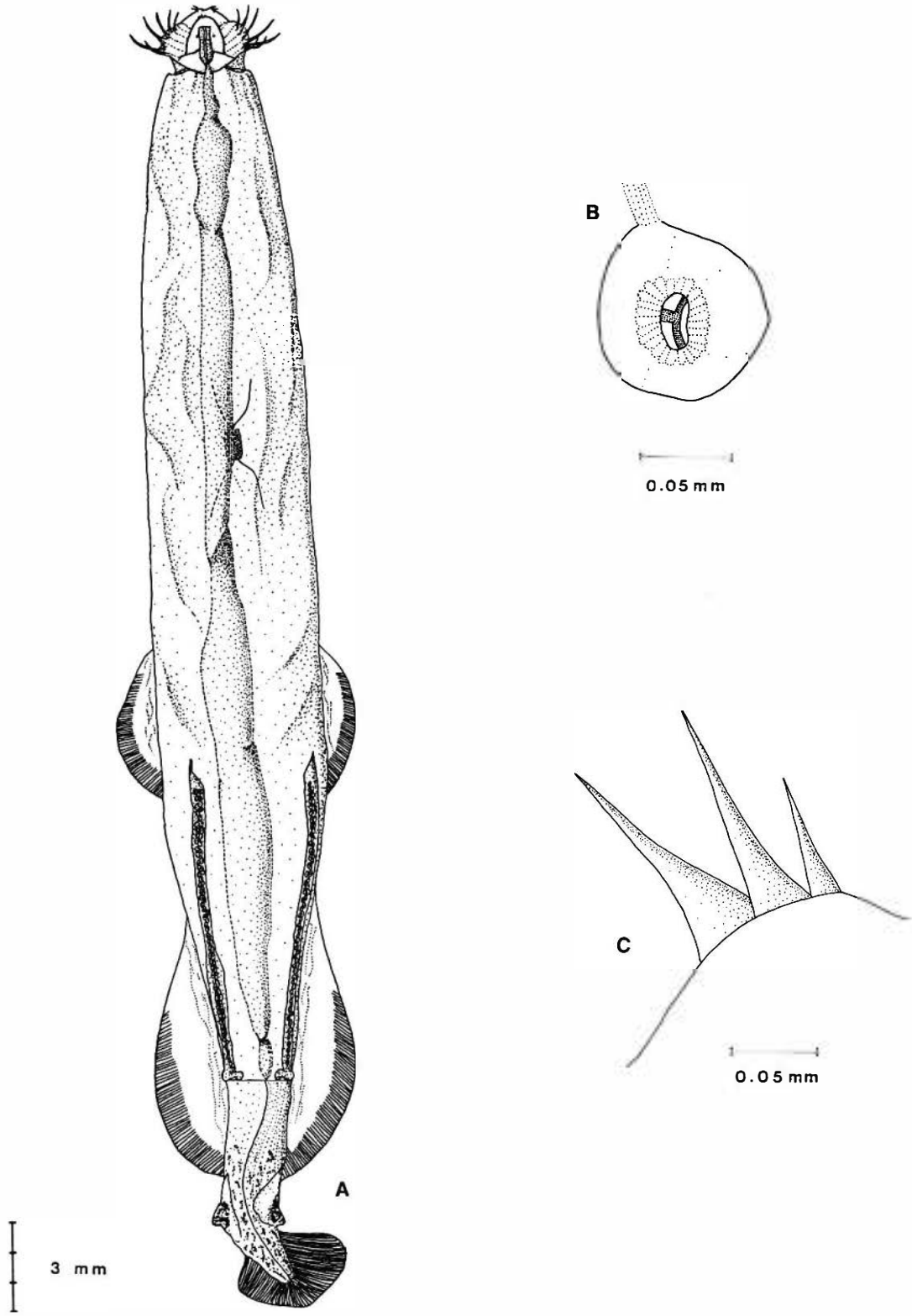
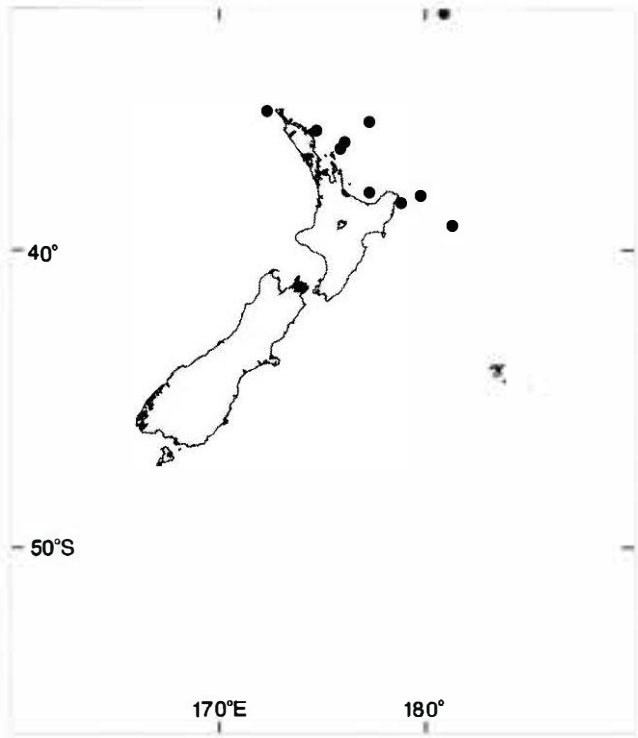


Fig. 7. A. *Flaccisagitta hexaptera* (maturity stage 2). B. Eye (right). C. Anterior teeth (left).

NEW RECORDS: *Flaccisagitta hexaptera* occurred at ten NZOI stations (Appendix 9) between 32°51'S and 38°50'S (Map 5). The southern limit of the distribution is defined by the Subtropical Convergence.

MATURITY STAGES: 5 (22.7%) of the 22 individuals of this species belonged to stage 0, 13 (59.1%) to stage 1, and 4 (18.2%) to stage 2. Average body length relating to the maturity stages and the preservation method is given in Appendix 8.



Map 5. New records of *Flaccisagitta hexaptera*.

Flaccisagitta enflata (Grassi, 1881) (Fig. 8)

Sagitta enflata Grassi, 1881.
Sagitta flaccida Conant, 1896.[3]
Sagitta gardineri Doncaster, 1903.[3]
Sagitta brachycephala Molchanov, 1907.[3]
Sagitta inflata Ritter-Záhony, 1908.[3]
Sagitta australis Johnston, 1909.[3]
Flaccisagitta enflata : Tokioka 1965.

DESCRIPTION: Size up to 30 mm. *Tail* 14–21% of total body length (Ritter-Záhony 1911). Anterior and posterior lateral *fins* approximately the same length; well separated from each other; the posterior fins with two-thirds of their length on the trunk; both fins rayed only on outer posterior edges. *Hooks* 8–11; *anterior teeth* 6–11; *posterior teeth* up to 16 (McLelland

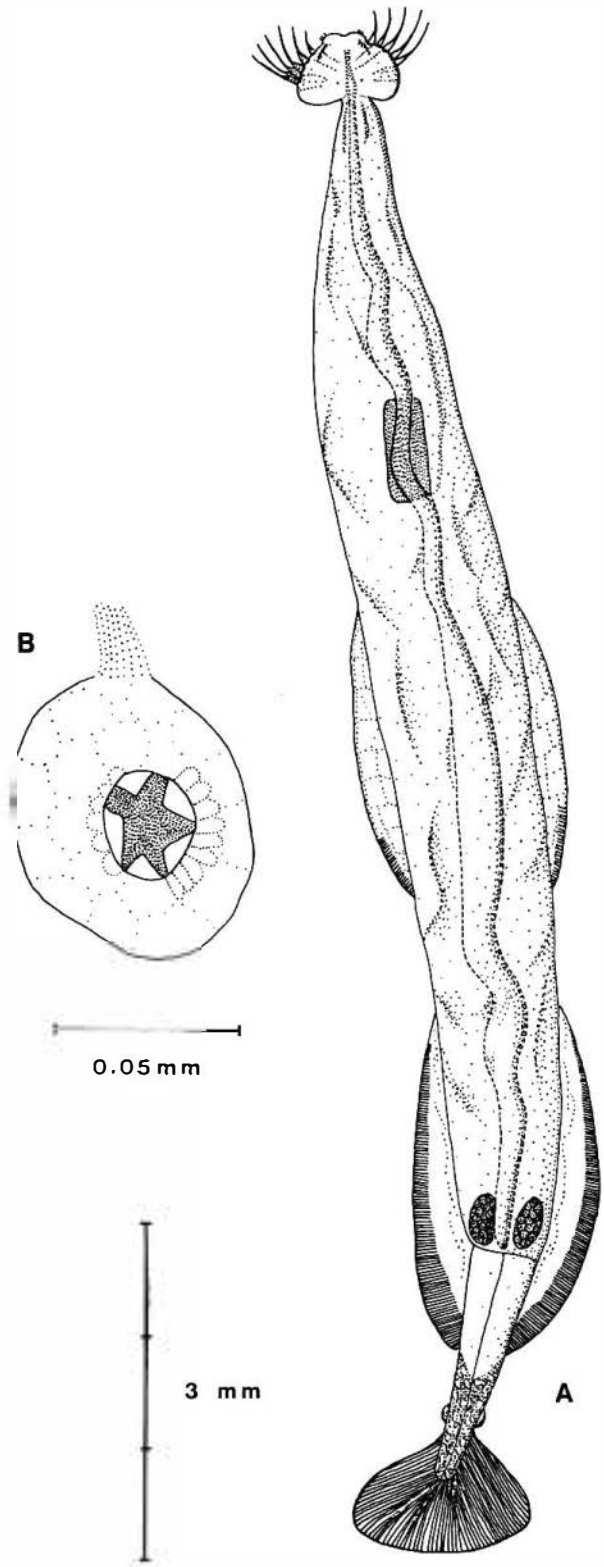


Fig. 8. A. *Flaccisagitta enflata* (maturity stage 2). **B.** Eye (right).

1988). *Eyes* round, with star-shaped pigment spot (Fig. 8B). *Corona ciliata* sinuous to hour-glass-shaped (Ritter-Záhony 1911). *Collarette* absent. *Ovaries*, short, club-shaped, reaching at most the posterior edge of the anterior lateral fins when mature. Spherical *seminal vesicles* contacting the caudal fin, well separated from the lateral fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Off southeastern Australia and Tasmania (Johnston & Taylor 1919; Dakin & Colefax 1940; Tokioka 1940; Thomson 1947; Taw 1978).

DISTRIBUTION: A cosmopolitan epiplanktonic species of temperate and warm waters (Alvariño 1965).

NEW RECORDS: Fiji: NZOI Stn B87, at Suva wharf. Tonga: NZOI Stn B78, east of Tongatapu (see Appendix 10 and Map 3).

MATURITY STAGES: Altogether 172 individuals of this species were found, 18 (10.5%) of them belonged to stage 0, 50 (29.0%) to stage 1, and 104 (60.5%) to stage 2. All specimens were preserved in 70% alcohol.

Pseudosagitta Germain & Joubin, 1912

Body flaccid but not as much as in *Flaccisagitta*. Lateral fins showing distinctive rayless zones. Short corona ciliata confined to the head. Intestinal diverticula absent. Anterior fins closely approach or are joined to the posterior fins by inflated tissue. Anterior fins approach or reach the ventral ganglion.

REMARKS: The genus *Pseudosagitta* contains the following species: *P. gazellae* (Ritter-Záhony, 1909); *P. lyra* (Krohn, 1853) (type species by synonymy); *P. maxima* (Conant, 1896); *P. scrippsae* (Alvariño, 1962).

The following species have been taken in the Southwest Pacific:

Pseudosagitta lyra (Krohn, 1853) (Fig. 9)

Sagitta lyra Krohn, 1853.
Sagitta furcata Steinhaus, 1896.[1]
Pseudosagitta grimaldii Germain & Joubin, 1912.[1]
Flaccisagitta lyra : Tokioka 1965.

DESCRIPTION: Size up to 42 mm. *Tail* 15–17% of total body length (Pierrot-Bults & Chidgey 1988). *Lateral fins* connected by a "fin bridge". *Anterior fins* emerge

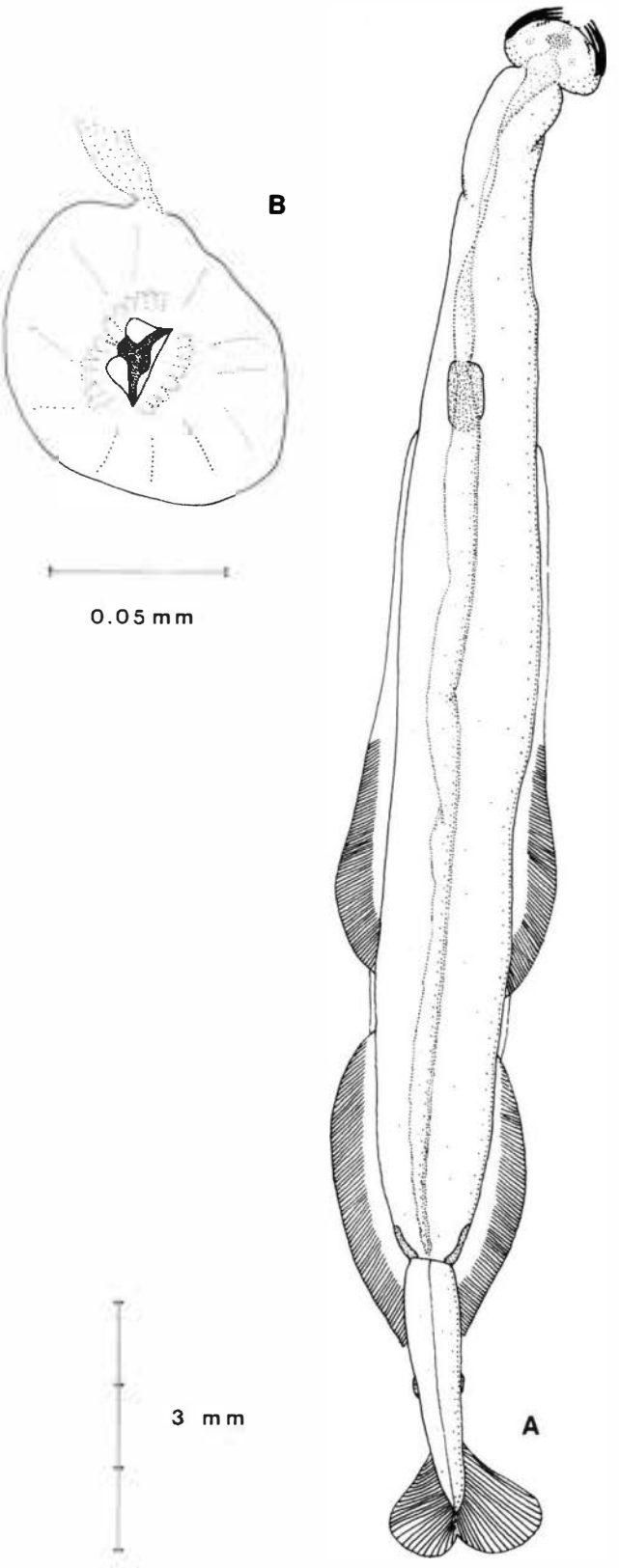


Fig. 9. **A**. *Pseudosagitta lyra* (maturity stage 1). **B**. Eye (right).

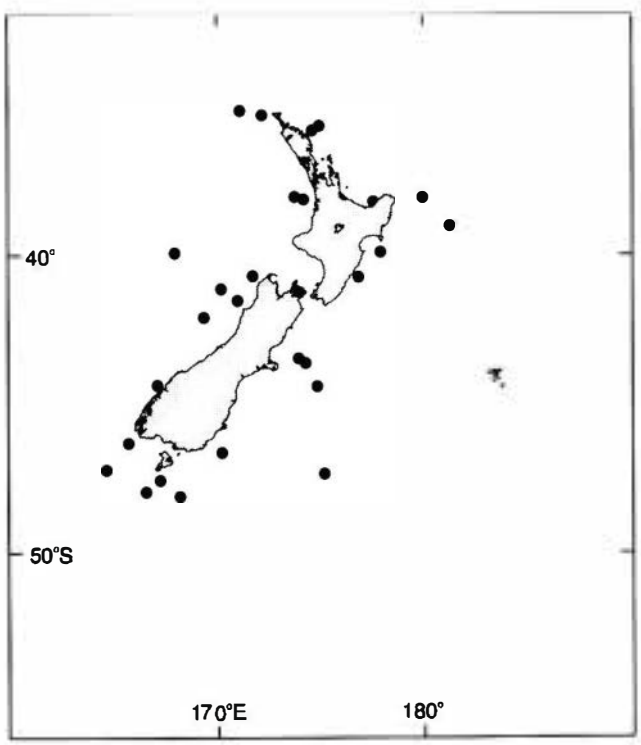
near the posterior edge of the ventral ganglion, becoming broader toward the rear end. Both fin pairs with large rayless zone, the anterior fins completely rayless anteriorly. *Hooks* up to 9; *anterior teeth* 3–8; *posterior teeth* up to 10 (McLelland 1988). *Eyes* with nearly T-shaped pigment spot (Fig. 9B). *Corona ciliata* pear-shaped or oval (Ritter-Záhony 1911). *Collarette* absent. Mature *ovaries* reaching the middle of the anterior fins. Spherical *seminal vesicles* separated from lateral and caudal fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Off southeastern Australia and Tasmania (Tokioka 1940; Dakin & Colefax 1940; Thomson, 1947; Taw 1978).

DISTRIBUTION: A cosmopolitan species of warm and temperate seas (Alvariño 1965).

NEW RECORDS: *Pseudosagitta lyra* occurred at 27 NZOI stations (Appendix 12) lying between 34°23.40'S and 47°57'S (Map 7). The southern limit of the distribution is defined by the Subtropical Convergence.

MATURITY STAGES: Of the 203 specimens of this species, 57 (28.1%) belonged to stage 0, 144 (70.9%) to stage 1, and 2 (1.0%) to stage 2. Average body length in relation to maturity and preservation is given in Appendix 11.



Map 6. New records of *Pseudosagitta lyra*.

Pseudosagitta gazellae (Ritter-Záhony, 1909) (Fig. 10)

Sagitta gazellae Ritter-Záhony, 1909.
Flaccisagitta gazellae : Tokioka 1965.

DESCRIPTION: Size up to 105 mm (David 1955). *Tail* less than 15% of total body length (Michael 1919). Young individuals with connected *lateral fins* which are later clearly separated (Ritter-Záhony, 1911). *Anterior fins* broader toward the posterior end, starting well separated from the ventral ganglion. The greater part of the *posterior lateral fins* on the trunk. Both fin pairs with an internal rayless zone, and the anterior fins also with a rayless anterior part. *Hooks* up to 14 (David 1955); *anterior teeth* up to 9; *posterior teeth* up to 11 (Ritter-Záhony, 1911). *Eyes* round with pigment spot candelabrum-shaped (Fig. 10B). *Corona ciliata* pear-shaped with sinuous outline and straight cross-portion in contrast to *P. lyra* (David 1955). *Collarette* absent. Mature *ovaries* attain more than 40% of total body length (David 1955). *Seminal vesicles* equidistant between posterior and caudal fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Ritter-Záhony, 1909; Burfield 1930). Off southeastern Australia and Tasmania (Taw 1978). Antarctic (David 1955).

DISTRIBUTION: A continuous circumpolar distribution in Antarctic and subantarctic waters (David 1955).

NEW RECORDS: *Pseudosagitta gazellae* was taken at 22 NZOI stations (Appendix 14) between 34°23.50'S and 75°56'S (Maps 7, 8).

MATURITY STAGES: 55 (51.4%) of the 107 specimens belonged to stage 0, 51 (47.7%) to stage 1, and only one (0.9%) to stage 2. The average body length in relation to maturity and preservation is given in Appendix 13.

Pseudosagitta maxima (Conant, 1896) (Fig. 11)

Sagitta maxima Conant, 1896.
Sagitta whartoni Fowler, 1896.[1]
Sagitta gigantea Broch, 1906.[1]
Flaccisagitta maxima : Tokioka 1965.

DESCRIPTION: Size up to 90 mm. *Tail* 19–25% of total body length (Ritter-Záhony 1911). Lateral fins connected. Anterior fins emerging at the anterior edge of the ventral ganglion, becoming broader posteriorly.

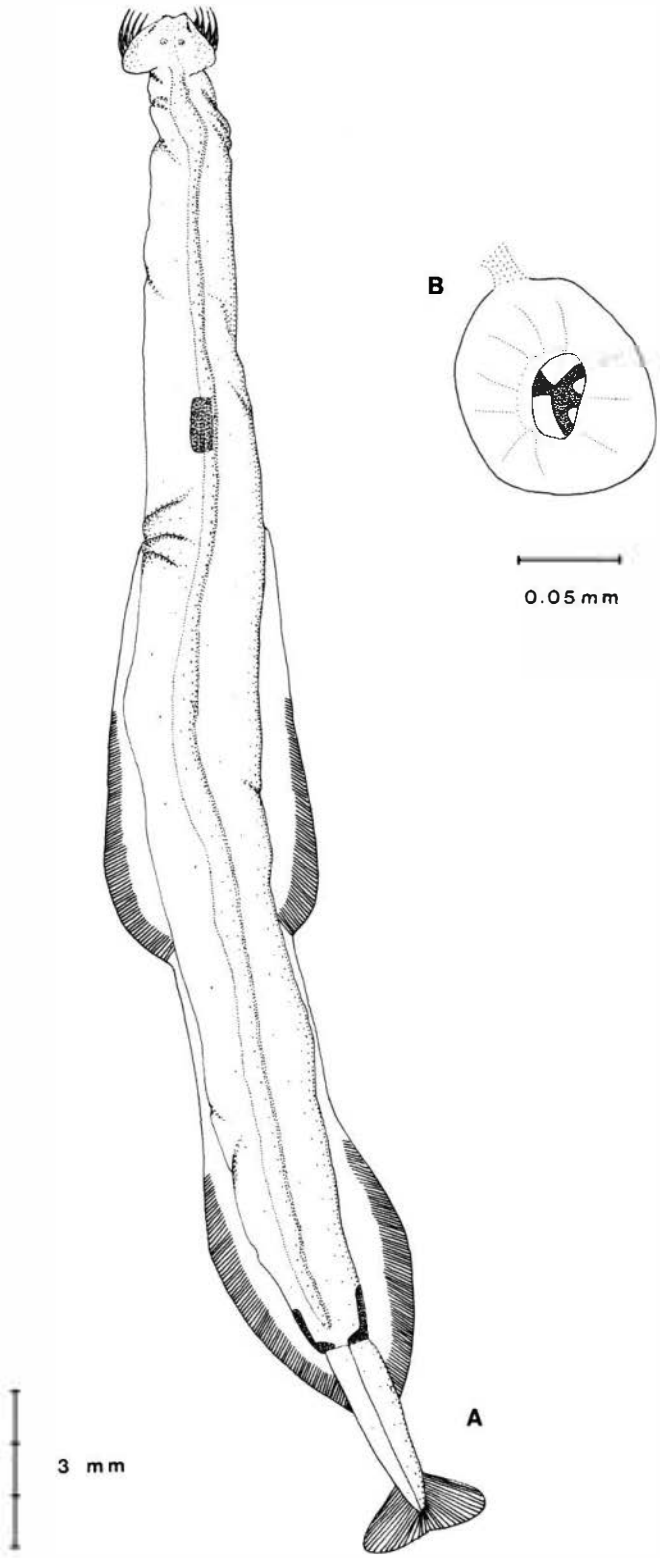
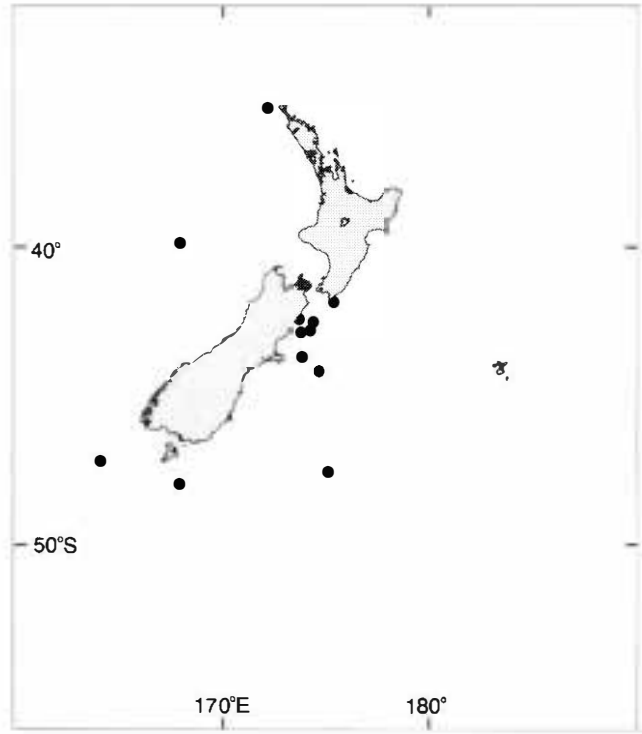
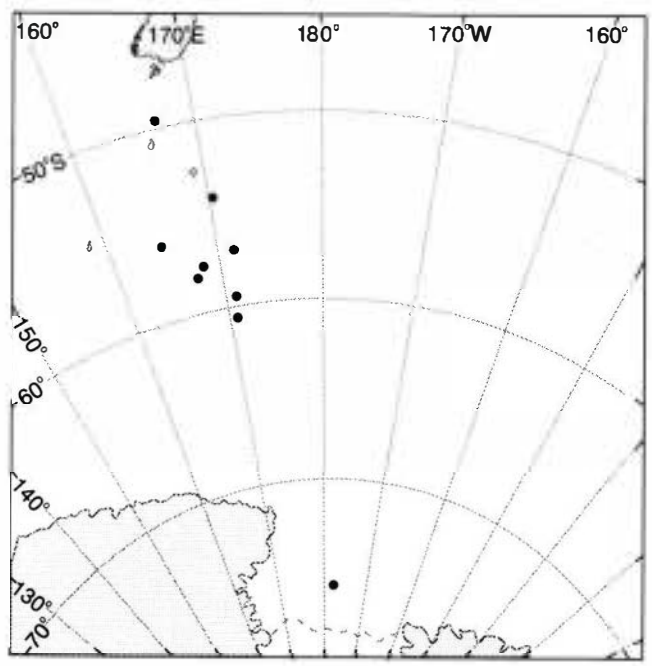


Fig. 10. **A.** *Pseudosagitta gazellae* (maturity stage 1). **B.** Eye (right).



Map 7. New records of *Pseudosagitta gazellae* (1).



Map 8. New records of *Pseudosagitta gazellae* (2).

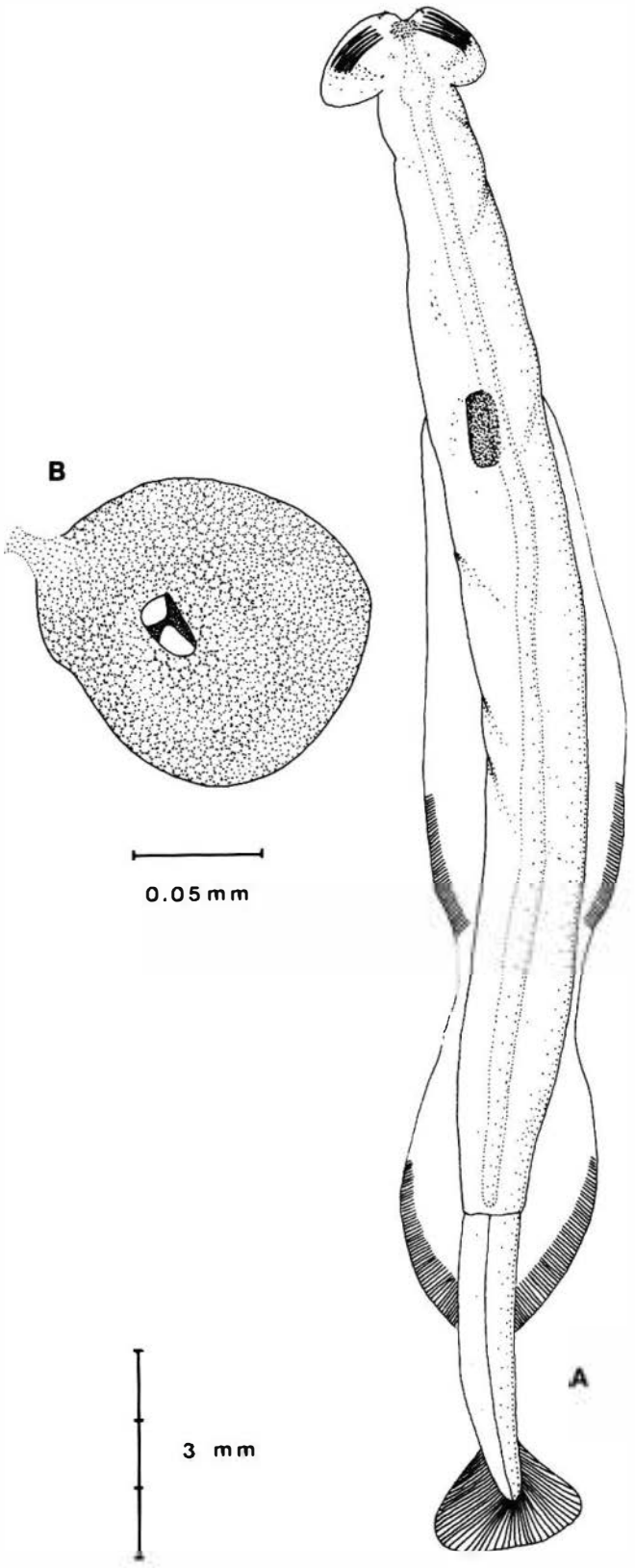


Fig. 11. **A.** *Pseudosagitta maxima* (maturity stage 0). **B.** Eye (right).

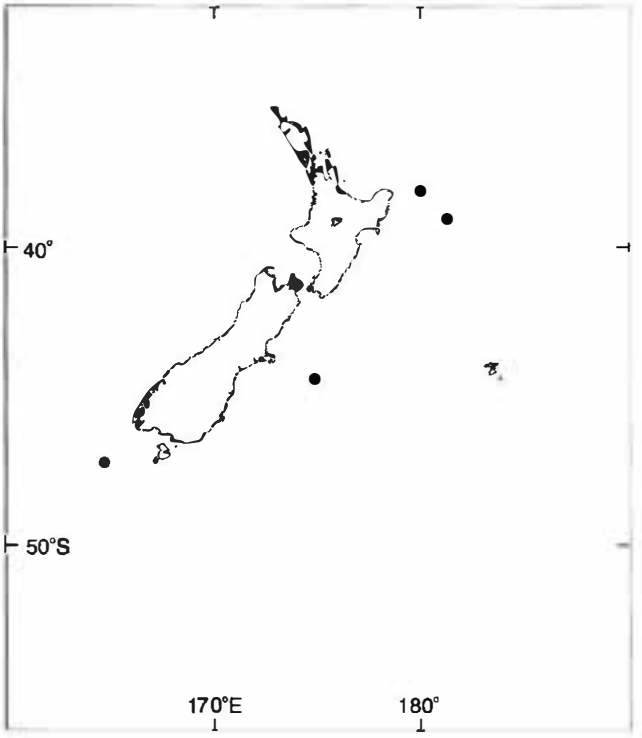
Fin rays in both fin pairs only on outer posterior edge. *Hooks* 5–11; *anterior teeth* 4–6; *posterior teeth* 5–8 (Pierrot-Bults & Chidgey 1988). *Eyes* with small T-shaped pigment spot (Fig. 11B). *Corona ciliata* pear-shaped (Ritter-Záhony 1911). *Collarette* absent. Mature ovaries not passing beyond the middle of the anterior lateral fins (Ritter-Záhony 1911). *Seminal vesicles* closer to lateral fins than to caudal fin.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Antarctic (David 1955).

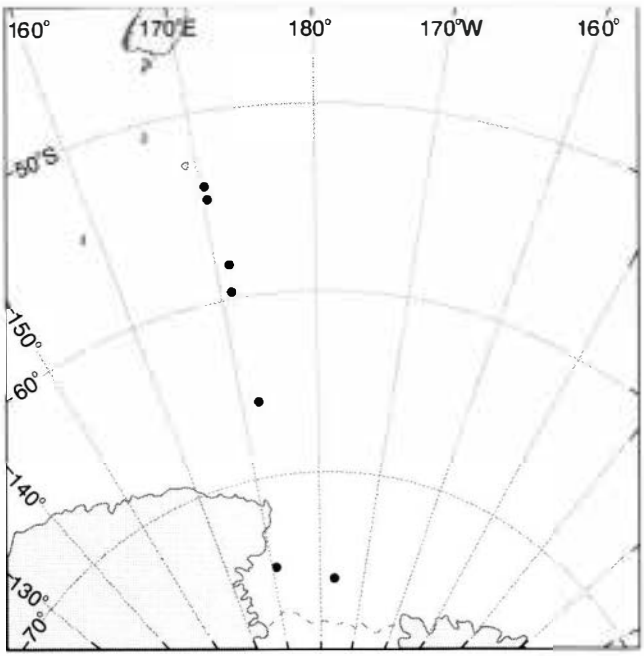
DISTRIBUTION: A cosmopolitan meso- or bathypelagic form (Alvariño 1965).

NEW RECORDS: *Pseudosagitta maxima* was found at 11 NZOI stations (Appendix 15) between 37°32'S and 75°56'S (Maps 9, 10).

MATURITY STAGES: All 47 specimens were preserved with 70% alcohol and were counted among stage 0. They averaged 12.46 mm long (6.0–25.0 mm).



Map 9. New records of *Pseudosagitta maxima* (1).



Map 10. New records of *Pseudosagitta maxima* (2).

Mesosagitta Tokioka, 1965

Corona ciliata beginning on the neck and passing posteriorly on to the anterior portion of the trunk. Intestinal diverticula present. Posterior fins lying more along the trunk than along the tail. Seminal vesicles situated apart from the posterior end of the posterior fins.

REMARKS: The genus *Mesosagitta* contains the following species: *M. decipiens* (Fowler, 1905); *M. exilis* Kassatkina, 1971; *M. minima* (Grassi, 1881) (type species); *M. sibogae* (Fowler, 1906).

The following species have been taken in the Southwest Pacific:

Mesosagitta minima (Grassi, 1881) (Fig. 12)

Sagitta minima Grassi, 1881.
Spadella minima : Grassi 1883.[3]
Mesosagitta minima : Tokioka 1965.

Description: Size up to 11 mm. *Tail* 16–24% of total body length (Sund 1959). Rounded *lateral fins* with sparse fin rays on marginal zones. *Anterior fins* slightly separated from ventral ganglion. Small head. *Hooks* 7–9; *anterior teeth* 3–7; *posterior teeth* 6–16 (Pierrot-Bults & Chidgey 1988). Small *eyes* with T-shaped pigment spot (Fig. 12B). *Collarette* absent. *Intestinal*

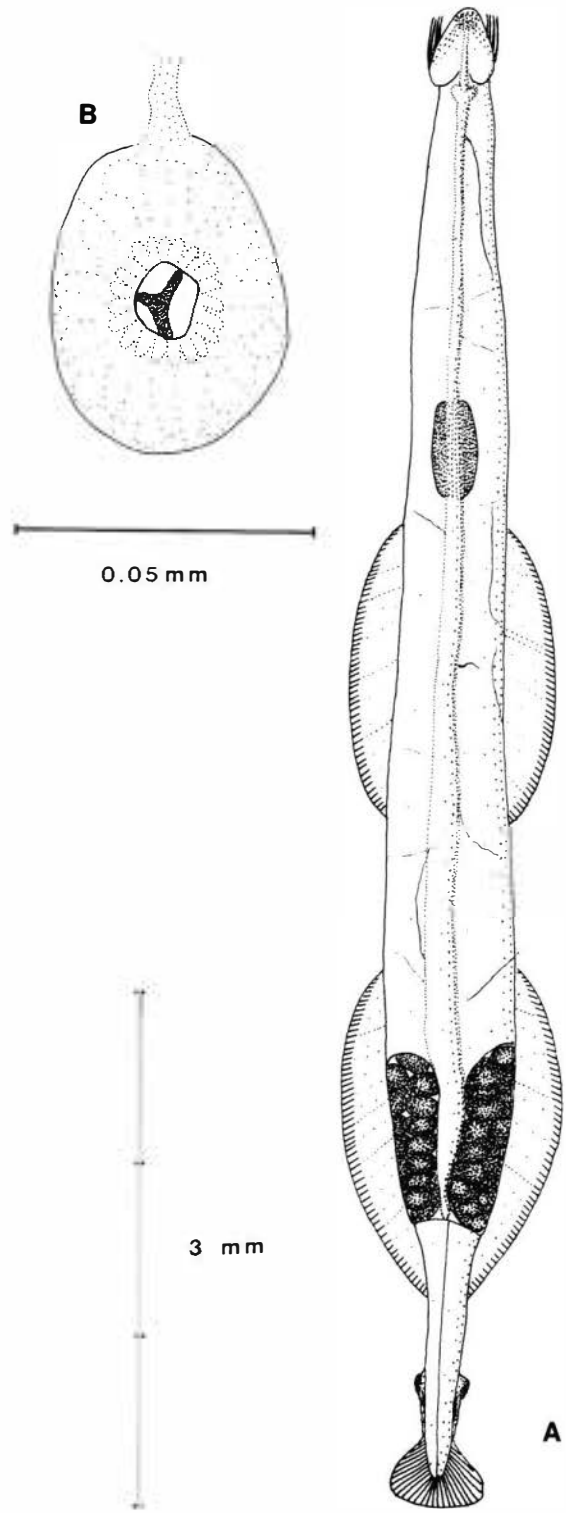


Fig. 12. A. *Mesosagitta minima* (maturity stage 2). **B.** Eye (right).

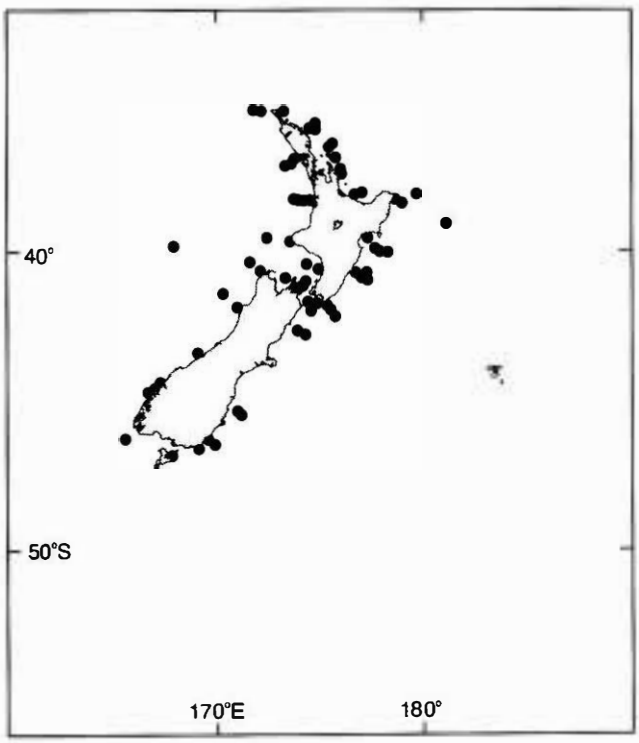
diverticula small. Mature *ovaries*, short and broad with few large ova. *Seminal vesicles* separated from posterior fins, contacting caudal fin.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off southeastern Australia and Tasmania (Johnston & Taylor 1919; Thomson 1947; Taw 1978).

DISTRIBUTION: A cosmopolitan epiplanktonic species (Alvariño 1965).

NEW RECORDS: *Mesosagitta minima* was taken at 84 NZOI stations (Appendix 17) between 34°23.40'S and 46°41.40'S (Map 11). The southern limit of distribution is defined by the Subtropical Convergence.

MATURITY STAGES: 2 (0.2%) of the 1086 specimens were counted to stage 0, 83 (7.6%) to stage 1, 814 (75.0%) to stage 2, 156 (14.4%) to stage 3, and 31 (2.8%) to stage 4. Average body length relating to the maturity stages and the preservation is given in Appendix 16.



Map 11. New records of *Mesosagitta minima*.

Mesosagitta decipiens (Fowler, 1905) (Fig. 13)

Sagitta decipiens Fowler, 1905.
Sagitta phillippini Michael, 1919.[2]
Sagitta neodecipiens Tokioka, 1959.[2]
Mesosagitta decipiens : Tokioka 1965.

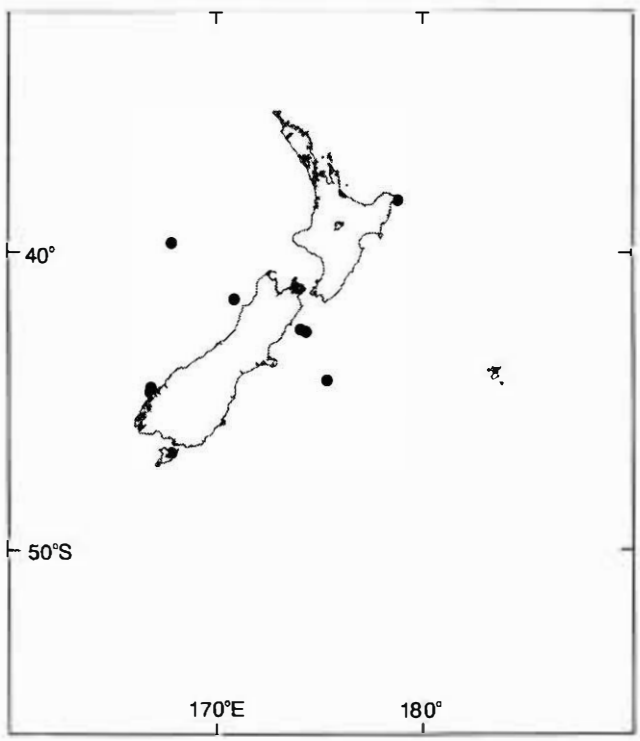
DESCRIPTION: Size up to 14 mm. *Tail* 19–32% of total body length (McLelland 1988). *Anterior fins* with rayless zone at their anterior end, emerging at the posterior edge of the ventral ganglion. *Posterior fins* also with rayless zone at anterior end, equally situated over trunk and tail segments. *Hooks* usually 6; *anterior teeth* 4–10; *posterior teeth* 6–18 (Pierrot-Bults 1979). *Eyes* with T-shaped pigment spot (Fig. 13B). *Corona ciliata* extending from neck to trunk and attaining between 1.5 and 2 times the head length (Ritter-Záhony 1911). Prominent *intestinal diverticula*. No *collarette*. Mature *ovaries* extending to anterior fins. *Seminal vesicles* equidistant from posterior and caudal fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off southeastern Australia and Tasmania (Thomson 1947).

DISTRIBUTION: A cosmospolitan, mesoplanktonic species of temperate and warm regions (Alvariño 1965).

NEW RECORDS: *Mesosagitta decipiens* was taken at nine NZOI stations (Appendix 19) between 37°44.20'S and 46°27.70'S (Map 12). The southern limit of distribution is defined by the Subtropical Convergence.

MATURITY STAGES: Of the 27 specimens, 3 (11.1%) belonged to stage 0, 13 (48.2%) to stage 1, 6 (22.2%)



Map 12. New records of *Mesosagitta decipiens*.

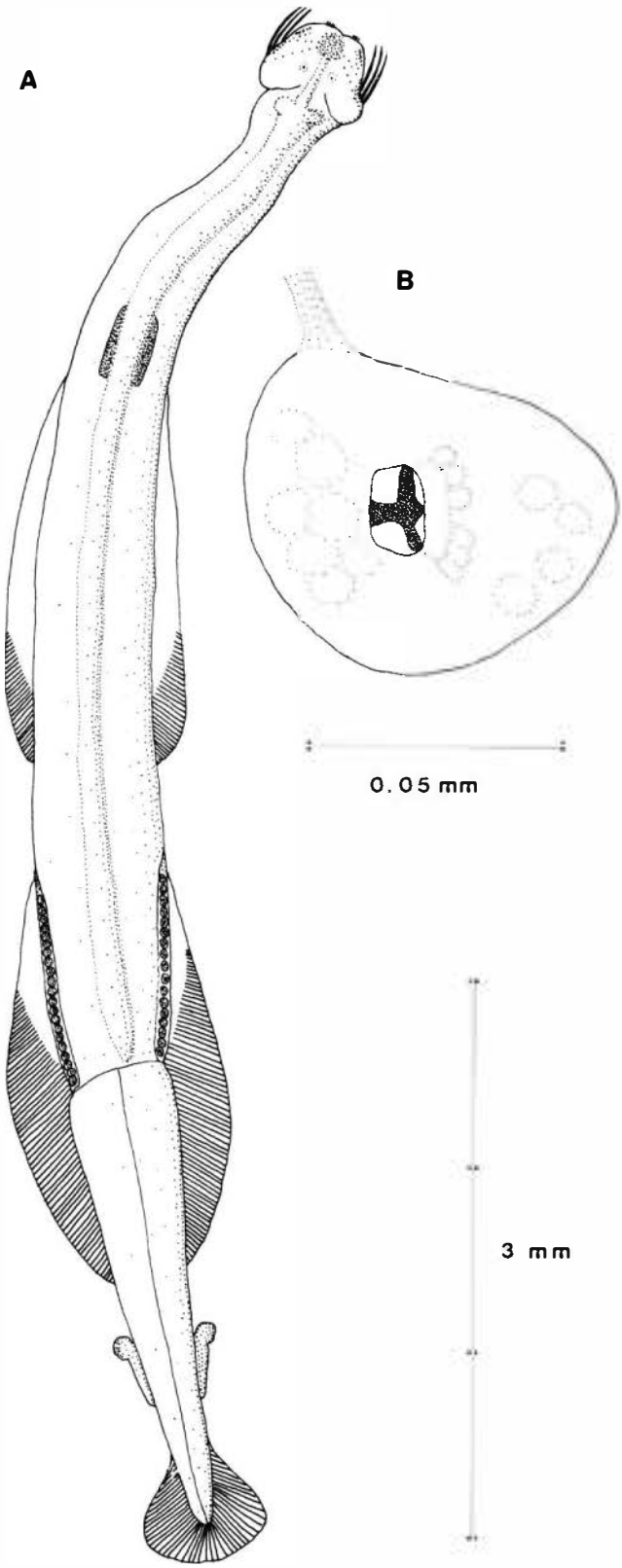


Fig. 13. **A.** *Mesosagitta decipiens* (maturity stage 2). **B.** Eye (right).

to stage 2, 4 (14.8%) to stage 3, and one (3.7%) to stage 4. Average body length relating to the maturity stages and the preservation method is given in Appendix 18.

Sagitta Quoy & Gaimard, 1827

Corona ciliata very elongated, beginning just behind the brain and extending on to the anterior portion of the trunk. Intestinal diverticula absent.

REMARKS: The genus *Sagitta* contains the following species: *S. bipunctata* Quoy & Gaimard, 1827 (type species); *S. bombayensis* Lele & Gae, 1936; *S. euxina* Molchanov, 1909; *S. friderici* Ritter-Záhony, 1911; *S. glacialis* Molchanov, 1907; *S. helenae* Ritter-Záhony, 1910; *S. megalophthalma* Dallot & Ducret 1969; *S. modesta* Kassatkina, 1971; *S. nagae* Alvariño, 1967; *S. nutana* Kassatkina, 1982; *S. pulchra* Doncaster, 1903; *S. setosa* Müller, 1847; *S. tenuis* Conant 1896.

Only one of these species occurs in the Southwest Pacific.

Sagitta bipunctata Quoy & Gaimard, 1827 (Fig. 14)

Sagitta multidentata Krohn, 1853.[1]
Spadella marioni Gourret, 1884.[1]
Sagitta californica Michael, 1913.[1]

DESCRIPTION: Size up to 19 mm. *Tail* 22–29% of total body length (Pierrot-Bults & Chidgey 1988). Anterior *fins* equally situated over trunk and tail segments. Both fin pairs entirely rayed. *Hooks* 5–10; *anterior teeth* 4–7; *posterior teeth* 8–14 (Sund 1959). *Eyes* with T-shaped pigment spot (Fig. 14B). Prominent *collarette* from neck to anterior lateral fins, between lateral fins and from posterior fins to seminal vesicles. Mature *ovaries* long, and able to reach the level of the ventral ganglion. *Seminal vesicles* separated from posterior fins, contacting caudal fin.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Off southeastern Australia and Tasmania (Johnston & Taylor 1919; Tokioka 1940; Dakin & Colefax 1940; Thomson 1947).

DISTRIBUTION: A cosmopolitan species of temperate and warm waters (Alvariño 1965).

NEW RECORDS: *Sagitta bipunctata* was found at 9 stations (Appendix 21) between 18°49'S and 51°31'S (Maps 3, 13). All except one specimen were taken north of the Subtropical Convergence.

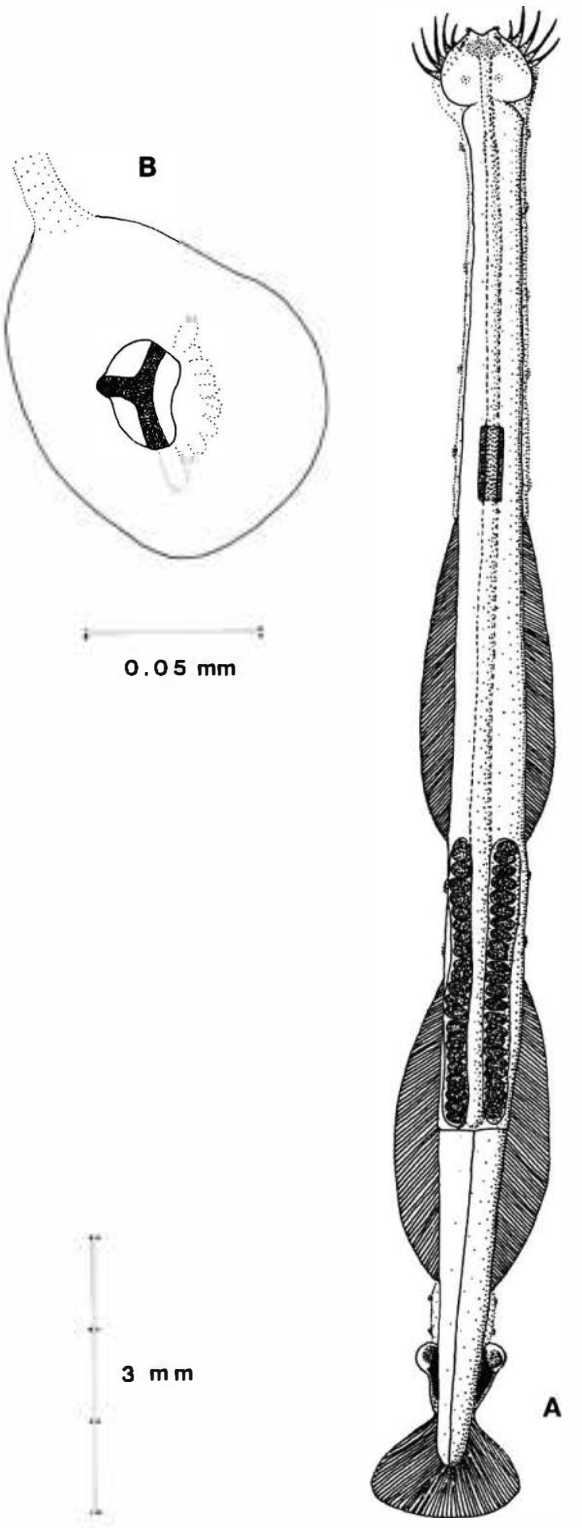
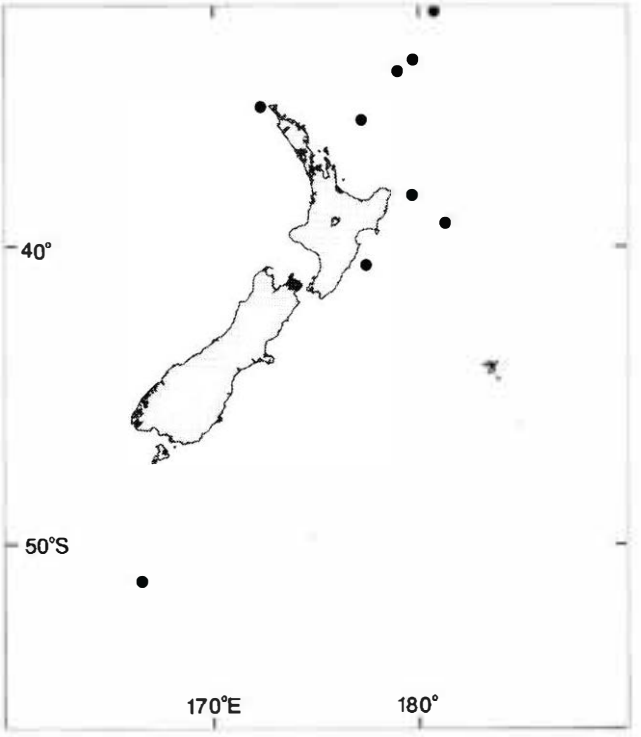


Fig. 14 A. *Sagitta bipunctata* (maturity stage 2). B. Eye (right).

MATURITY STAGES: Of the 202 individuals, 61 (30.2%) were classed with stage 0, 51 (25.3%) with stage 1, 51 (25.3%) with stage 2, 33 (16.3%) with stage 3, and 6 (2.9%) with stage 4. Average body length relating to maturity and preservation is given in Appendix 20.



Map 13. New records of *Sagitta bipunctata*.

Serratosagitta Tokioka & Pathansali, 1963

Corona ciliata beginning behind the brain and extending on to the anterior portion of the trunk. Intestinal diverticula absent. Hooks serrated.

REMARKS: The genus *Serratosagitta* contains the following species: *S. bieri* (Alvariño, 1961); *S. pacifica* (Tokioka, 1940); *S. pseudoserratodentata* (Tokioka, 1939); *S. serratodentata* (Krohn, 1853) (type species); *S. tasmanica* (Thomson, 1947).

The following species have been taken in the Southwest Pacific:

Serratosagitta pacifica (Tokioka, 1940) (Fig. 15)

Sagitta serratodentata f. *pacifica* Tokioka, 1940.[1]
Sagitta serratodentata pacifica : Thomson 1947.[1]
Sagitta pacifica : Bieri 1957.[1]
Serratosagitta pacifica : Tokioka 1965.

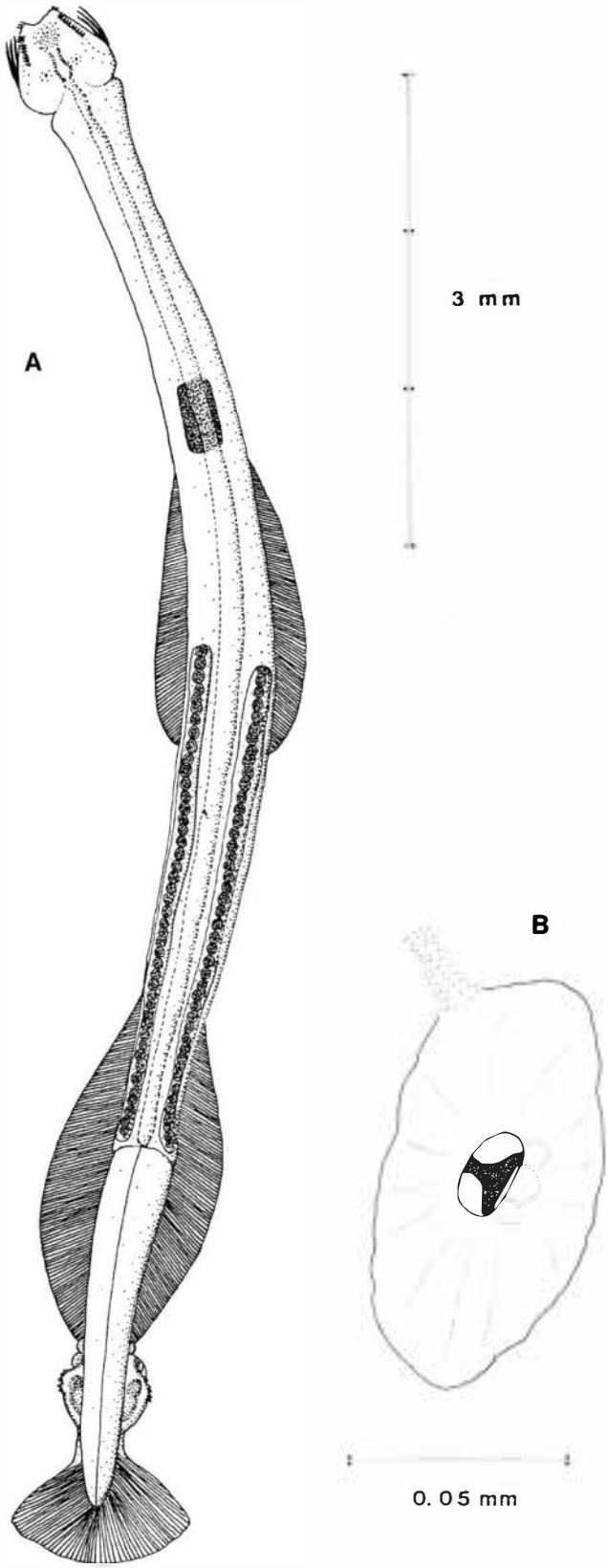


Fig. 15. A. *Serratosagitta pacifica* (maturity stage 2). **B.** Eye (right).

DESCRIPTION: Size up to 14 mm (Alvariño 1969). *Tail* 21–26% of total body length (Pierrot-Bults 1974). *Lateral fins* entirely rayed. *Anterior fins* slightly separated from ventral ganglion. *Hooks* 5–8 (sometimes 9), serrated; *anterior teeth* 3–12; *posterior teeth* 8–23 (Pierrot-Bults 1974). Oval *eyes* with T-shaped pigment spot (Fig. 15B). *Corona ciliata* double the head length (Tokioka 1940). A thin *collarette* occurs on the neck, and between the seminal vesicles and caudal fins. Mature *ovaries* reaching the anterior edge of the ventral ganglion. *Seminal vesicles* contacting lateral fins, slightly separated from caudal fin, with cells forming an irregular tooth-like row.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Southeastern Australia (Thomson 1947).

DISTRIBUTION: An epiplanktonic Indo-Pacific species also occurring in the Red Sea (Alvariño 1965) with a cosmopolitan warm-water distribution according to Bieri (1959).

NEW RECORDS: *Serratosagitta pacifica* was taken at only one NZOI station (B78) (Appendix 22) at 18°49'S, east of Tonga (Map 3).

MATURITY STAGES: Both specimens were 10 mm long and preserved in 70% alcohol. They belonged to maturity stage 2.

Serratosagitta serratodentata (Krohn, 1853) (Fig. 16)

Sagitta serratodentata Krohn, 1853.
Sagitta serrulata Cleve, 1905.[3]
Spadella serratodentata : Grassi 1883.[3]
Sagitta serratodentata f. *atlantica* Tokioka, 1940.[1]
Sagitta serratodentata atlantica f. *typica* Tokioka, 1952.[1]
Sagitta serratodentata atlantica : Tokioka 1959.[1]
Serratosagitta serratodentata : Tokioka 1965.

DESCRIPTION: Size up to 13 mm. *Tail* 23–28% of total body length (McLelland 1988). *Anterior fins* emerging at posterior end of ventral ganglion, totally rayed. *Posterior fins* with small internal rayless zones. *Hooks* 5–8 (sometimes 9), serrated (Fig. 15C); *anterior teeth* 6–10; *posterior teeth* 15–20 (McLelland 1988). Oval *eyes* with T-shaped pigment spot (Fig. 16B). *Corona ciliata* at least double the head length (Ritter-Záhony 1911). A thin *collarette* at the neck and in the region of the seminal vesicles. Mature *ovaries* extending to the ventral ganglion. *Seminal vesicles* almost contacting the lateral fins, separated from caudal fins, with two anterolateral papillae when mature.

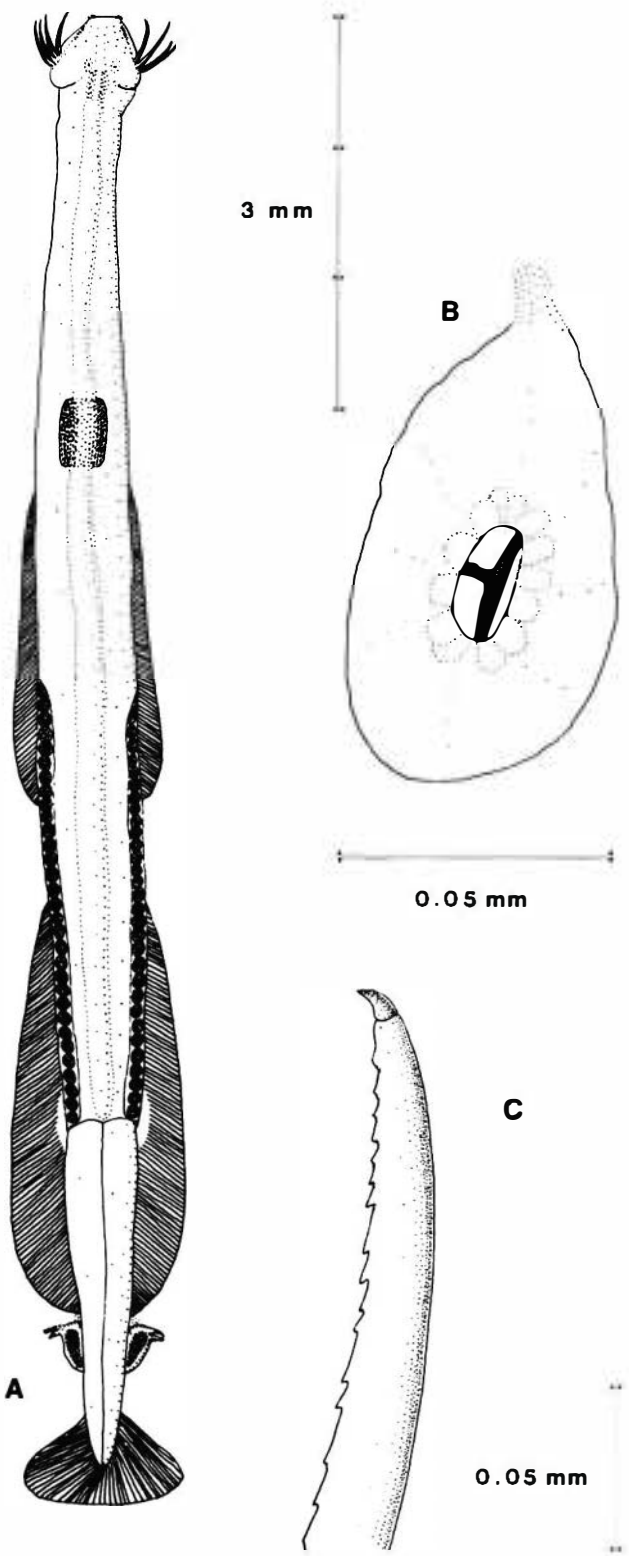


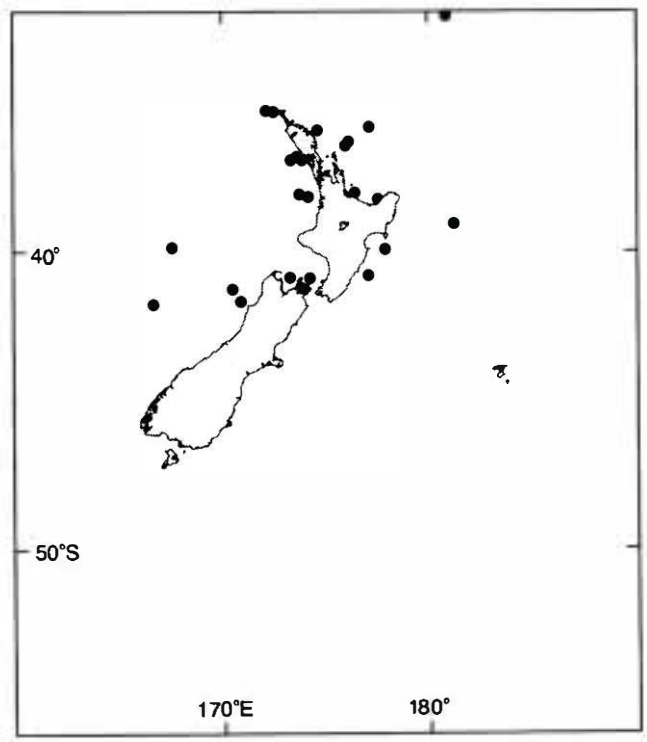
Fig. 16. A. *Serratosagitta serratodentata* maturity stage 2). **B.** Eye (right). **C.** Hook (right).

PREVIOUS SOUTH-WEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930; Jillett 1971). Off south-eastern Australia and Tasmania (Tokioka 1940; Thomson 1947; Taw 1978). Antarctic (Burfield 1930).

DISTRIBUTION: An epiplanktonic species of temperate and warm waters (Alvariño 1965).

NEW RECORDS: *Serratosagitta serratodentata* was taken at 27 NZOI stations (Appendix 24) between 18°49'S and 64°54'S (Maps 3, 14, 15).

MATURITY STAGES: 451 specimens were taken, 17 (3.7%) at stage 0, 108 (24.0%) at stage 1, 261 (57.9%) at stage 2, 61 (13.5%) at stage 3, and 4 (0.9%) at stage 4. Average body length in relation to maturity and preservation method is given in Appendix 23.

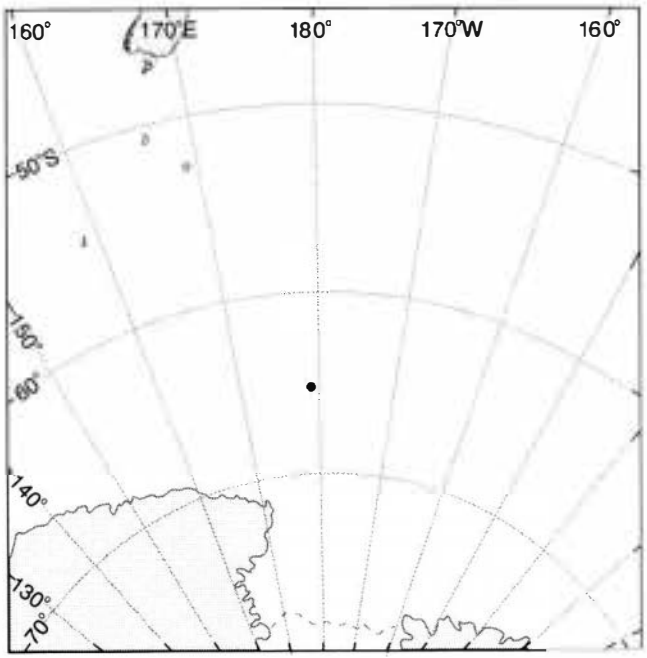


Map 14. New records of *Serratosagitta serratodentata* (1).

Serratosagitta tasmanica (Thomson, 1947)
(Fig. 17)

Sagitta serratodentata tasmanica Thomson, 1947.
Sagitta serratodentata atlantica f. *tasmanica* : Tokioka 1952.[1]
Sagitta selkirki Fagetti, 1958.[1]
Serratosagitta tasmanica : Tokioka 1965.

DESCRIPTION: Size up to 20 mm. Tail 20–30% of total



Map 15. New records of *Serratosagitta serratodentata* (2).

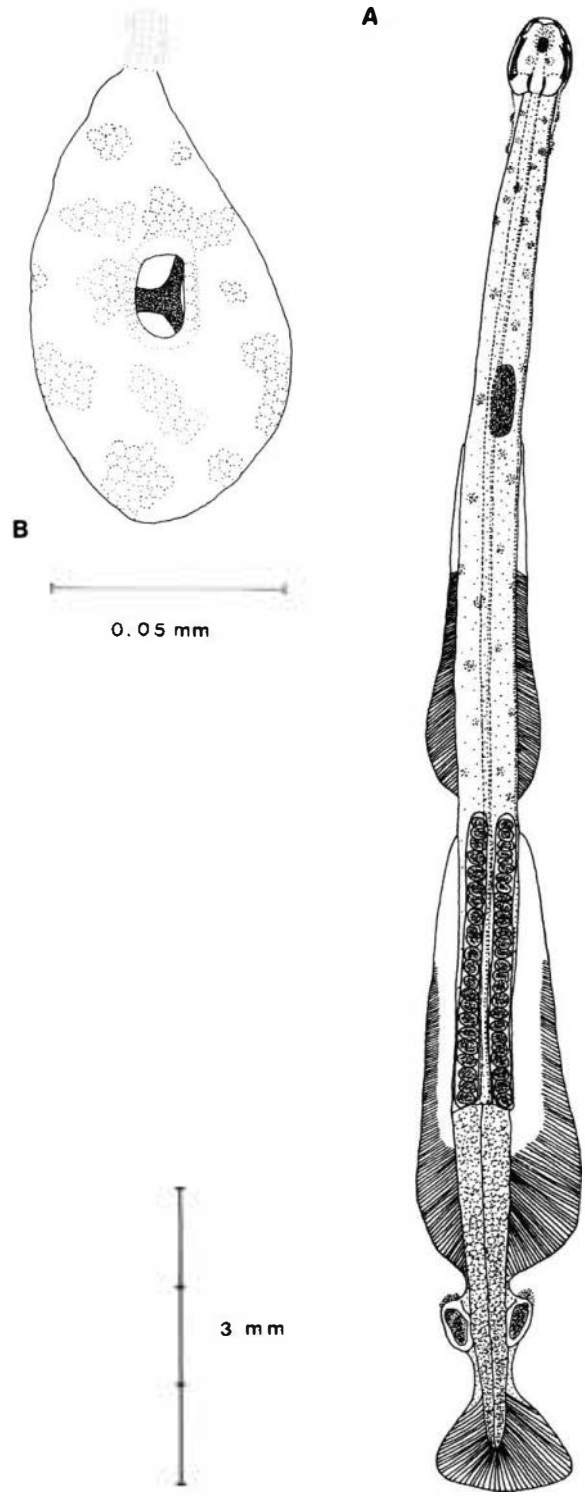


Fig. 17. A. *Serratosagitta tasmanica* (maturity stage 2). B. Eye (right).

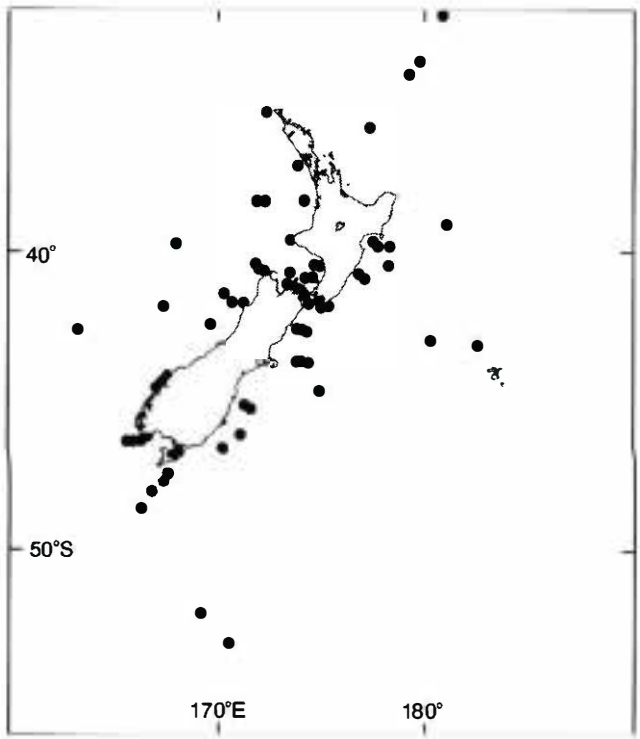
body length (Pierrot-Bults 1974). *Anterior fins* beginning approximately at the level of the ventral ganglion and broadening at their posterior end. Their anterior part is rayless. *Posterior fins* slightly longer, nearly reaching the anterior fin pair. Anterior and inner part without fin rays. *Hooks* 6–8 (sometimes 9), serrated; *anterior teeth* 2–9; *posterior teeth* 3–15 (Pierrot-Bults 1974). Oval *eyes* with T-shaped pigment spot (Fig. 17B). A vestige of a *collarette* occurs at the neck and between the posterior and caudal fins. Mature *ovaries* reaching the anterior end of the anterior fins. *Seminal vesicles* lying closer to lateral fins than to caudal fin, without contacting them.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off southeastern Australia and Tasmania (Thomson 1947; Taw 1978).

DISTRIBUTION: An epiplanktonic species of subantarctic waters and the southernmost part of the Indian and Pacific Oceans (Alvariño 1964), and also reported from the northeastern Atlantic (Pierrot-Bults & Chidgey 1988).

NEW RECORDS: *Serratosagitta tasmanica* was found at 90 NZOI stations (Appendix 26) between 30°06'S and 53°26.30'S (Map 16). Most specimens were taken north of the Subtropical Convergence. This counters the idea of Alvariño (1965) that the Subtropical Convergence acts as a barrier to the northward extension of this species.

MATURITY STAGES: 24 (0.8%) of the 2869 individuals were classed at stage 0, 343 (12.0%) at stage 1, 2404 (83.8%) at stage 2, 96 (3.3%) at stage 3, and 2 (0.1%) at stage 4. Average body length in relation to maturity and preservation is given in Appendix 25.



Map 16. New records of *Serratosagitta tasmanica*.

Solidosagitta Tokioka, 1965

Prominent intestinal diverticula. Posterior lateral fins lying more on trunk than on tail. Corona ciliata extending from neck to anterior trunk portion. Small pigmented area compared with the size of the eye.

REMARKS: The genus *Solidosagitta* contains the following species: *S. marri* (David, 1956); *S. planctonis* (Steinhaus, 1896) (type species); *S. zetesios* (Fowler, 1905).

The following species was taken in an NZOI sample from Antarctic waters.

Solidosagitta marri (David, 1956) (Fig. 18)

Sagitta marri David, 1956.
Solidosagitta marri : Tokioka 1965.

DESCRIPTION: Size up to 28.5 mm. *Tail* 20–28% of total

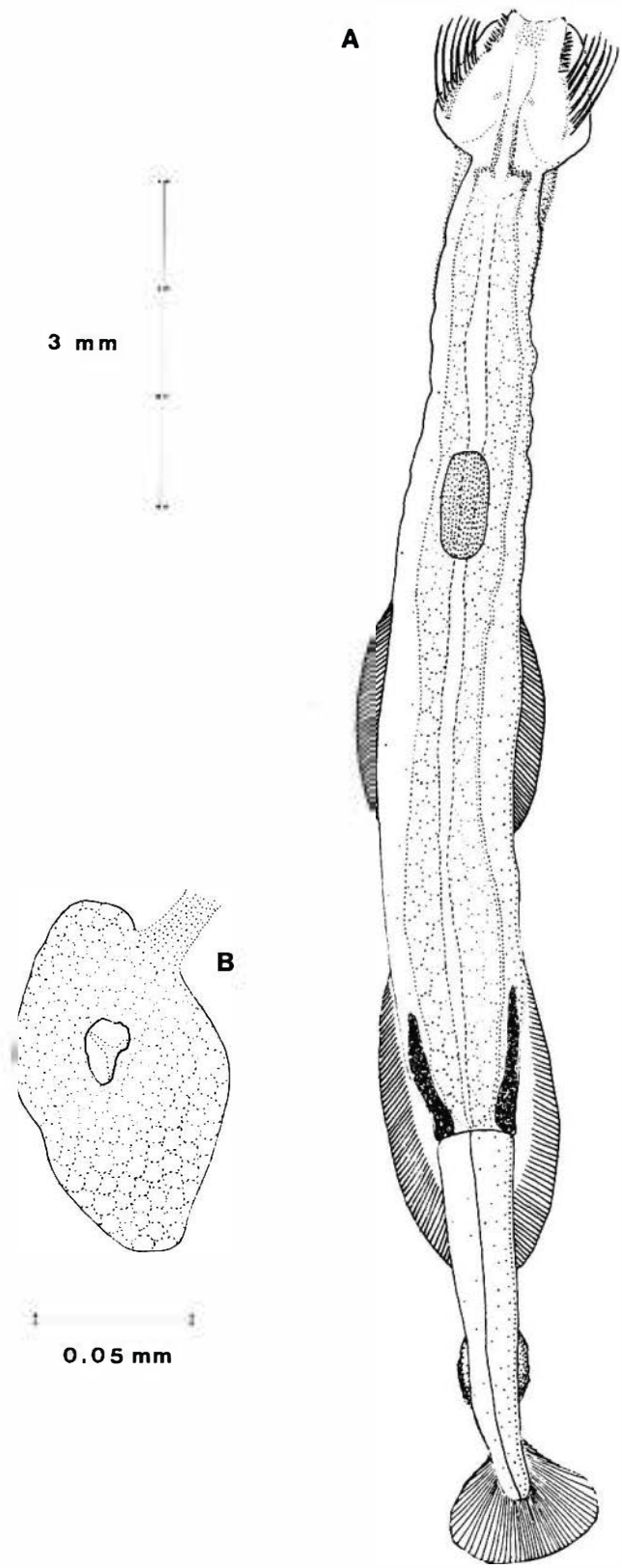


Fig. 18. A. *Solidosagitta marri* (maturity stage 2). **B.** Eye (right).

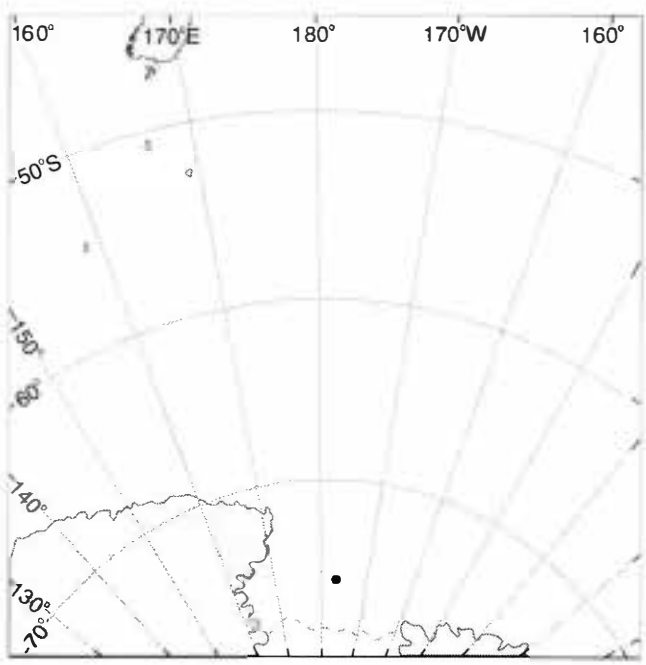
body length (David 1956). *Anterior fins* entirely rayed, slightly separated from ventral ganglion, with a length of 10–19% of the total body length (David 1956). *Posterior fins* with internal rayless zone. *Hooks* 7–11 (usually 8–9); *anterior teeth* up to 8 (usually 6–7); *posterior teeth* up to 17 (usually 14–15) (David 1956). *Eyes* with small, delicate, T-shaped pigment spot (Fig. 18B). *Corona ciliata* commences at the posterior end of the head and reaches about one-third of the distance to the ventral ganglion (David 1956). *Collarette* prominent in the neck region, but very thin on remainder of body. Mature *ovaries* may reach ventral ganglion (O'Sullivan 1982). *Seminal vesicles* lying separated from caudal fin and lateral fins.

PREVIOUS SOUTHWEST PACIFIC RECORDS: None.

DISTRIBUTION: An endemic meso-, bathyplanktonic Antarctic chaetognath (Alvariño 1965).

NEW RECORDS: *Solidosagitta marri* was taken in one sample (Appendix 27) from 75°56'S (Map 17).

MATURITY STAGES: 3 specimens were taken; 2 belonged to stage 1, both of which were 9.0 mm long, and 1 with a size of 14.5 mm belonged to stage 2. They were all preserved in 70% alcohol.



Map 17. New record of *Solidosagitta marri*.

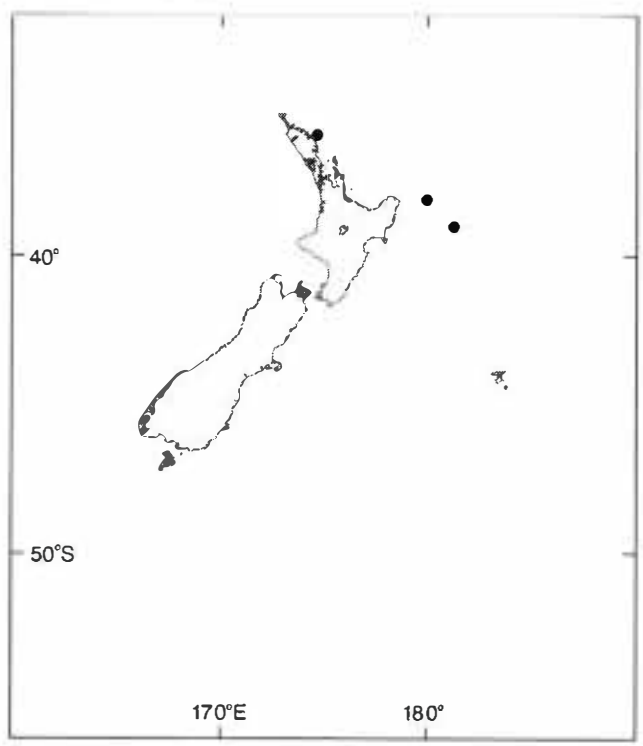
Solidosagitta zetesios (Fowler, 1905) (Fig. 19)

Sagitta zetesios Fowler, 1905.
Solidosagitta zetesios : Tokioka 1965.

DESCRIPTION: Size up to 40 mm. *Tail* 20–23% (David 1956). *Anterior fins* rayless at the anterior end, beginning at the posterior edge of the ventral ganglion, with a length of 20–26% of total body length (David 1956). *Posterior fins* triangular, anterior and inner part without fin rays. *Hooks* up to 11 (usually 8–10); *anterior teeth* up to 12 (usually 8–10); *posterior teeth* up to 22 (usually 15–19) (David 1956). *Eyes* with small T-shaped pigment spot (Fig. 19B). *Corona ciliata* commences at the posterior end of the head and extends to about half way between the head and ventral ganglion (David 1956). A prominent *collarette* extending to the tail in fully grown specimens (O'Sullivan 1982). Prominent *intestinal diverticula*. Mature *ovaries* reaching to half way between the head and ventral ganglion; *seminal vesicles* in contact with posterior fins (O'Sullivan 1982).

DISTRIBUTION: A cosmopolitan mesoplanktonic species of temperate and warm regions.

NEW RECORDS: *Solidosagitta zetesios* was taken at three NZOI stations (Appendix 29) between 35°07.40'S and 38°50'S (Map 18).



Map 18. New records of *Solidosagitta zetesios*.

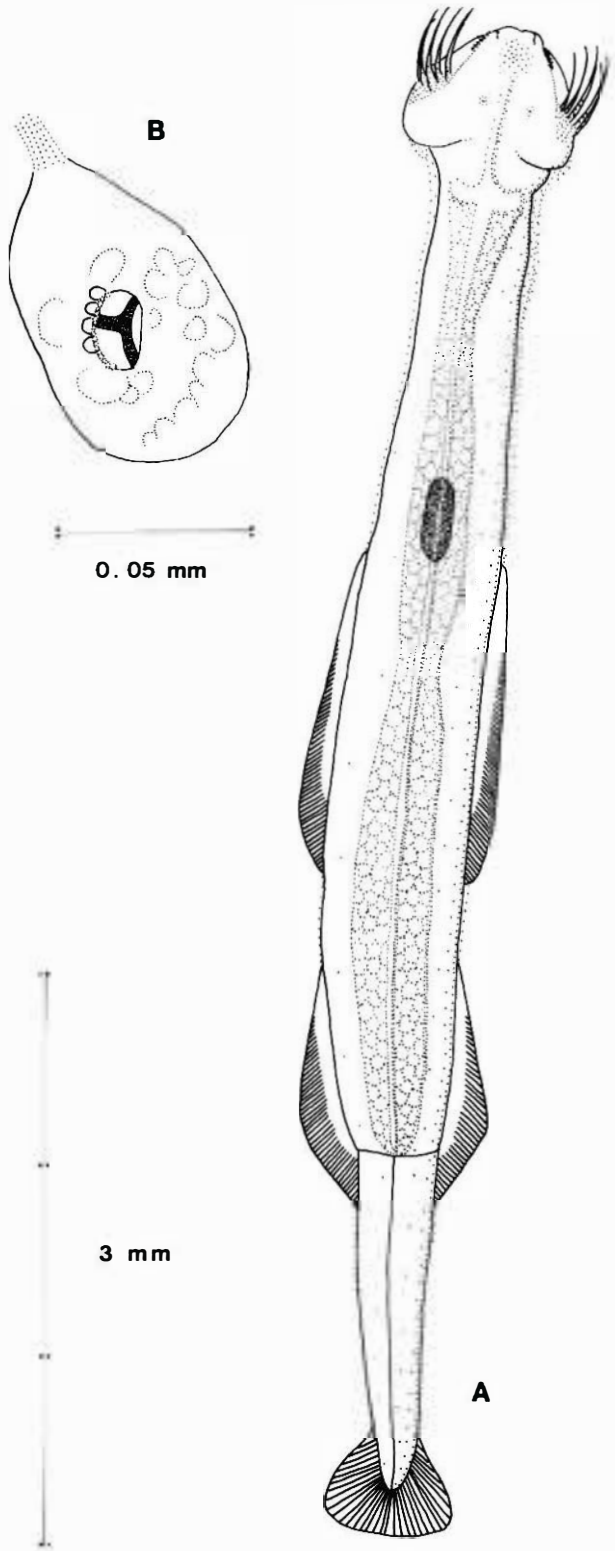


Fig. 19. A. *Solidosagitta zetesios* (maturity stage 2). B. Eye (right).

MATURITY STAGES: All 32 individuals belonged to stage 0. Average body length in relation to maturity and preservation is given in Appendix 28.

Family EUKROHNIIDAE Tokioka, 1965

One pair of lateral fins beginning far anterior to the trunk-tail septum near the level of the ventral ganglion. One row of teeth. No alimentary diverticula. Tail segment comparatively short.

Eukrohnia Ritter-Záhony, 1909

Diagnosis as for family.

REMARKS: The genus *Eukrohnia* contains the following species: *E. bathyantarctica* David, 1958; *E. bathypelagica* Alvariño, 1962; *E. calliops* McLelland, 1989; *E. flaccicoeca* Casanova, 1986; *E. fowleri* Ritter-Záhony, 1909; *E. hamata* (Möbius, 1875) (type species); *E. kitoui* Kuroda, 1981; *E. macroneura* Casanova, 1986; *E. minuta* Silas & Srinivasan, 1968; *E. molchanovi* Kassatkina, 1982; *E. proboscidea* Furnestin & Ducret, 1965.

The following species has been taken in the Southwest Pacific:

Eukrohnia hamata (Möbius, 1875) (Fig. 20)

Sagitta hamata Möbius, 1875.
Krohnia hamata : Langerhans 1880.[1]
Spadella hamata : Hertwig 1880.[3]
Krohnia foliacea Aida, 1897.[1]
Krohnia hamata var. *borealis* Molchanov 1907.[1]
Eukrohnia hamata : Ritter-Záhony 1909.
Eukrohnia richardi Germain & Joubin, 1912.[1]
Eukrohnia hamata var. *antarctica* Johnston & Taylor, 1921.[1]

DESCRIPTION: Size up to 43 mm. *Tail* 19–25% of total body length (Pierrot-Bults & Chidgey 1988). One pair of long lateral *fins*, extending from the middle of the ventral ganglion to the seminal vesicles, with fin rays only in the posterior third. *Hooks* 7–9 (Fig. 19D), with bristles in juveniles (Fig. 19C); *teeth* 2–26 (Pierrot-Bults & Chidgey 1988). Oval *eyes* without pigment (Fig. 20B). *Corona ciliata* situated on head and trunk, reaching head length (Ritter-Záhony 1911). No *collarette*. Mature *ovaries* reaching about half the trunk length; *seminal vesicles* elongated, close to lateral fins (Pierrot-Bults & Chidgey 1988).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Off northern New Zealand (Burfield 1930). Off southern New

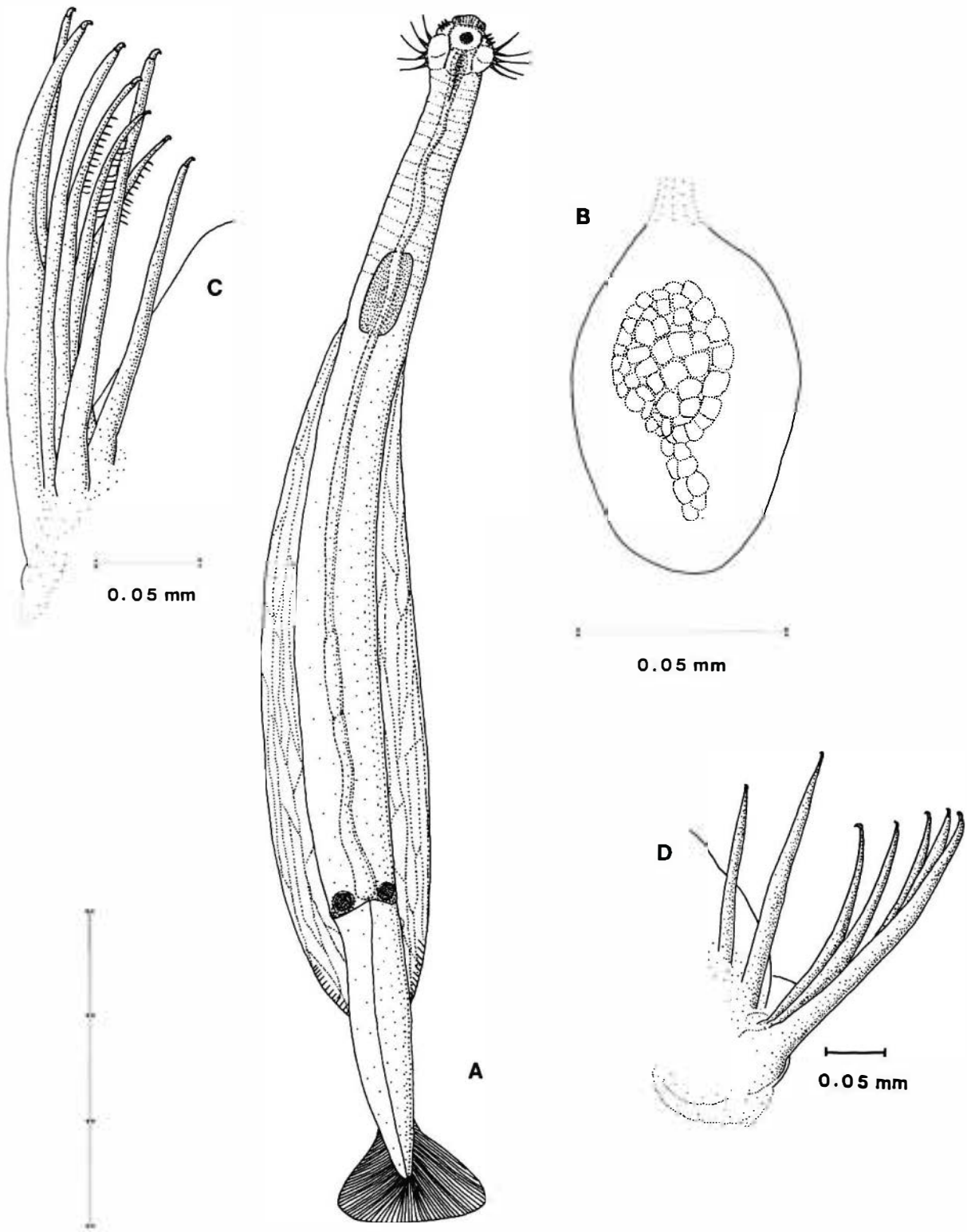


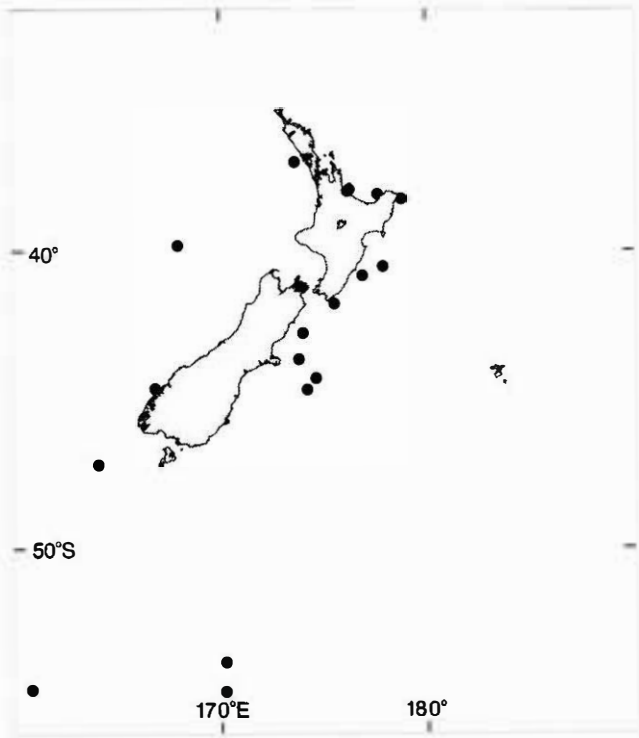
Fig. 20. **A.** *Eukrohnia hamata* (maturity stage 1). **B.** Eye (right). **C.** Hooks of juvenile (left). **D.** Hooks of adult (right).

Zealand (Parker 1895). Off southeastern Australia and Tasmania (Thomson 1947; Taw 1978). Antarctica (Johnston & Taylor 1921).

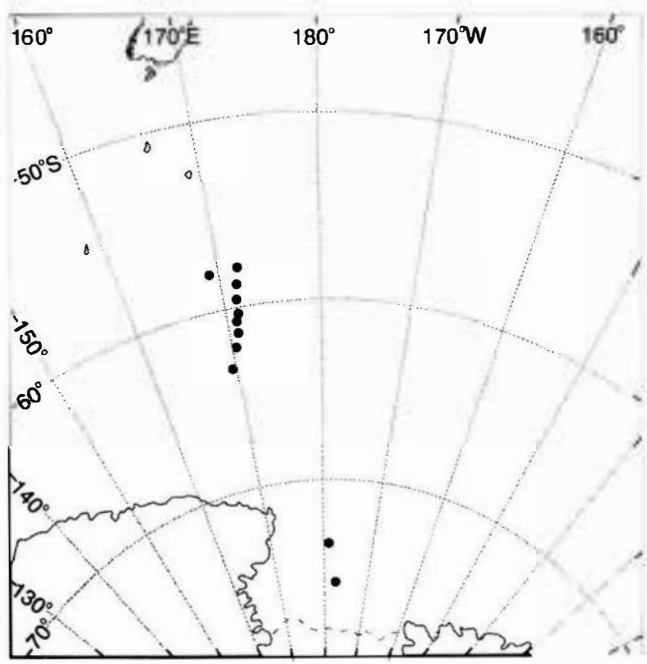
DISTRIBUTION: *Eukrohnia hamata* occurs in the meso- and bathypelagic layers of the tropical and equatorial regions, but rises to epiplanktonic levels or even the surface in cold areas (Alvariño 1965). This species is cosmopolitan in the deep sea and circumpolar, with its maximum abundance in the Southern Ocean in the vicinity of the Antarctic Convergence (David 1958).

NEW RECORDS: *Eukrohnia hamata* was taken at 29 NZOI stations (Appendix 31), between 36°23.60'S and 75°56'S (Maps 19, 20).

MATURITY STAGES: 179 (44.4%) of the 403 specimens belonged to stage 0, 207 (51.4%) to stage 1, and 17 (4.2%) to stage 2. Average body length in relation to maturity and preservation is given in Appendix 30.



Map 19. New records of *Eukrohnia hamata* (1).



Map 20. New records of *Eukrohnia hamata* (2).

DISCUSSION

SPECIES COMPOSITION

The species diversity represented in the N.Z. Oceanographic Institute samples may be compared with that of Burfield (1930). He analysed the material taken by the "Terra Nova" expedition and divided the New Zealand region into three areas —

* North of New Zealand and adjacent waters (33–35°S, 171–174°E).
* Subantarctic (40–60°S, 158°05'E–78°54'W)
* Antarctic (61°18'S–77°15'S, 175°33'E–166°W).

He found the following 13 species:

Sagitta bipunctata Quoy & Gaimard, 1827
Flaccisagitta hexaptera (d'Orbigny, 1843)
Pseudosagitta lyra (Krohn, 1853)
Serratosagitta serratodentata (Krohn, 1853)
Pterosagitta draco (Costa, 1869)
Eukrohnia hamata (Möbius, 1875)
Krohnitta subtilis (Grassi, 1881)
Flaccisagitta enflata (Grassi, 1881)
Sagitta bedoti Béraneck, 1895
Solidosagitta planctonis (Steinhaus, 1896)
Pseudosagitta maxima (Conant, 1896)
Ferrosagitta robusta (Doncaster, 1902)
Pseudosagitta gazellae (Ritter-Záhony, 1909)

Burfield's (1930) identification of *Solidosagitta planctonis* was probably in error. The statements about tail length (24–30%) and the number of anterior (7–11) as well as posterior (15–19) teeth do not accord with this species. He suggested that some of his *S. planctonis* specimens belonged to *Ferosagitta robusta* but his attribution to this species is also in doubt. Most likely there was some confusion with *Solidosagitta zetesios* or *S. marri*.

Burfield (1930) also included *Sagitta bedoti* in his species list, however this species was not found in the NZOI samples. Alvariño (1965) was also in doubt about this record of *S. bedoti* which was far south of the otherwise known distribution. Because of similarities to *Aidanosagitta neglecta* in its general appearance, the collarette, and the stellate pigment spots of the eyes, confusion with this species appears possible, although the tooth formula and the absence of rays in the lateral fins, mentioned by Burfield, do not concur with *A. neglecta*.

It is surprising that Burfield (1930) did not find the two most numerous and widespread species of the NZOI samples, *Serratosagitta tasmanica* and *Mesosagitta minima*. However, since *S. tasmanica* was not described as a new taxon until 1947 by Thomson, it is almost certain that some of the 6514 specimens of *Serratosagitta serratodentata* identified by Burfield were individuals of *S. tasmanica*.

It is especially surprising that *Mesosagitta minima* was not found by Burfield. Perhaps he confused it with *Sagitta bedoti*. He mentioned that the rayless anterior parts of both lateral fin pairs approach the condition found in *M. minima*, but the length of the tail and the number of teeth given by Burfield do not accord with *M. minima*.

NORTH–SOUTH DISTRIBUTION

The NZOI sampling stations cover four climatic regions, characterised as tropical, subtropical, subantarctic, and antarctic (Koppen 1931; Wooster & Cromwell 1958). Based on their north-south distribution (Fig. 21), South Pacific chaetognath species may be classified geographically as follows.

Tropical species are those occurring between the Tropics of Cancer and Capricorn (23°28'N–23°28'S). *Aidanosagitta neglecta*, *Ferosagitta robusta*, *Flaccisagitta enflata*, and *Serratosagitta pacifica* are found mostly in this region but some authors have reported these species sporadically in subtropical regions of the Pacific. Alvariño (1964) describes *Ferosagitta robusta* as tropico-equatorial. Burfield (1930) also found this species in the warmer waters of the New Zealand region between 33° and 35° S. Along the east coast of Australia it has been found up to 38°S (Thomson 1947). The southern limit of *Aidanosagitta neglecta* in the Pacific Ocean is given as 16°S (Alvariño 1964). In the western Pacific this species extends more towards the south, into the subtropical region (Johnston & Taylor 1919; Thomson 1947). *Serratosagitta pacifica* and *Flaccisagitta enflata* also occur in subtropical waters. *Serratosagitta pacifica* has been taken at 35°S (Alvariño 1964) and 38°S (Thomson 1947). The southern limit of *Flaccisagitta enflata* in the Pacific Ocean is 34°S (Alvariño 1964) to 40°S (Bieri 1959).

A second group of species comprises those occurring in the subtropical region. Their southern limit is the Subtropical Convergence, defined for New Zealand by Garner (1962).

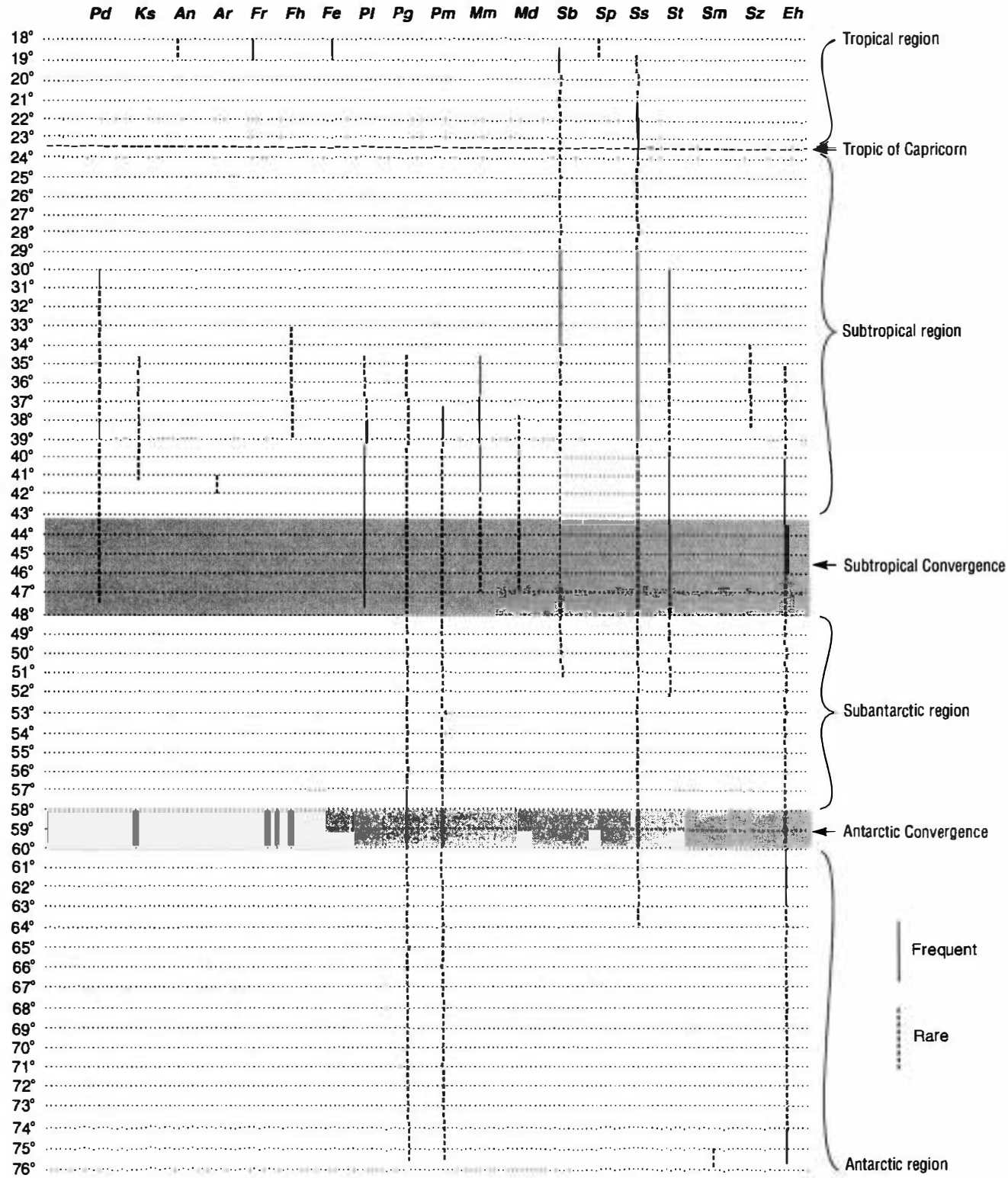


Fig. 21.

North–south distribution of chaetognath species in the Southwest Pacific, based on NZOI samples and published records.

Pd = *Pterosagitta draco*
Ks = *Krohnitta subtilis*
An = *Aidanosagitta neglecta*
Ar = *A. regularis*
Fr = *Ferosagitta robusta*
Fh = *Flaccisagitta hexaptera*
Fe = *F. enflata*
Pl = *Pseudosagitta lyra*
Pg = *P. gazellae*
Pm = *P. maxima*
Mm = *Mesosagitta minima*
Md = *M. decipiens*
Sb = *Sagitta bipunctata*
Sp = *Serratosagitta pacifica*
Ss = *S. serratodentata*
St = *Serratosagitta tasmanica*
Sm = *Solidosagitta marri*
Sz = *S. zetesios*
Eh = *Eukrohnia hamata*

To this group belong *Pterosagitta draco, Krohnitta subtilis, Aidanosagitta regularis, Flaccisagitta hexaptera, Pseudosagitta lyra, Mesosagitta minima, M. decipiens,* and *Solidosagitta zetesios,* as based on the NZOI material. With the exception of *P. lyra,* this finding accords with previous literature (Burfield 1930; David 1958; Bieri 1959; Alvariño 1964). All previous records of *P. lyra* have been found north of the Subtropical Convergence, but it seems that this is not the southern limit of this species. David (1958) also reported *P. lyra* in the subtropical region. The Pacific distribution of *P. lyra* is not, however, restricted to the Kuroshio region and the South China Sea as reported by Alvariño (1965). The species occurs in the Southeast Pacific, along the coast of Chile (Fagetti 1972) and Burfield (1930) found specimens in the material of the "Terra Nova" expedition between 33°S and 35°S.

Sagitta bipunctata occurs in the tropical and subtropical regions of the southern hemisphere (Alvariño 1964). Apart from one NZOI specimen taken south of the Subtropical Convergence at 51°13'S, this distribution is confirmed by the present work. Very probably it represents a periodic incursion of warmer water southwards. David (1958) noted how individuals of species normally limited by the Subtropical Convergence can sometimes be found 2° or 3° south of this front. In this case the Subtropical Convergence would have to have deviated to a maximum of 48°S.

Serratosagitta tasmanica has been found in both subtropical and subantarctic waters, with the majority north of the Subtropical Convergence. The northernmost South Pacific record of this species was 30°06'S, which counters the idea of Alvariño (1965) that the Subtropical Convergence represents the northern limit for this species in the SW Pacific.

Tokioka (1940) has made a distinction between two forms of *Sagitta serratodentata* along the coast of New South Wales, namely *S. serratodentata* f. *atlantica* and *S. serratodentata* f. *pacifica.* The former was noted as a full subspecies by Tokioka (1959). The only difference from *S. serratodentata* (Krohn, 1853) is the number of posterior teeth — *S. serratodentata* has 5–20, and *S. serratodentata atlantica* 6–17 (Pierrot-Bults 1974). Nevertheless Doncaster (1903) previously stated that the number of teeth often varies in widespread species. Therefore this characteristic should not be used to classify subspecies. Furnestin (1953) believed that *S. serratodentata* (Krohn) and *S. serratodentata sensu* Tokioka are identical. I agree with this opinion. The majority of NZOI individuals of this species were netted in the subtropical region. One specimen originated from the tropics (18°49'S) and another from the antarctic region (64°54'S). The material of the "Terra Nova" expedition included *S. serratodentata* from 33°S to 77°30'S (Burfield 1930) (certainly also including specimens of *S. tasmanica*).

Pseudosagitta maxima, P. gazellae, and *Eukrohnia hamata* have been found in subtropical, subantarctic, and antarctic samples. David (1955) described the distribution of *P. maxima* as circumpolar along the West Wind Drift. He stated that the northern limit is located a little north of the Subtropical Convergence and the southern limit is not far south of the Antarctic Convergence. The present results support Alvariño' s (1965) statement that *P. maxima* also occurs in antarctic waters.

Eukrohnia hamata shows a bipolar distribution with submergence in the tropics (David 1958). Here, individuals of this species live at great depths, occurring progressively closer to the surface in subantarctic and subarctic regions (Alvariño 1964). *Pseudosagitta maxima* also shows this kind of distribution (Alvariño 1964). This "diving" should be the reason for the absence of *E. hamata* and *P. maxima* in the tropical surface samples.

Pseudosagitta gazellae is a subantarctic–antarctic species, occurring in the southern parts of the Atlantic, Pacific, and Indian Oceans (Alvariño 1965). The northern specimens around New Zealand have been found in the subtropical region at 34°23.50'S. David (1955) differentiates two races of this species, separated from each other by the Antarctic Convergence. The smaller race, living in subantarctic surface waters, reaches a body length of 68 mm maximum; the larger southern race reaches 105 mm. The distinctive characteristic is the development of the ovaries. For this reason the two races can be distinguished only at a minimum length of ~ 25 mm. At this length the visual development of the gonads starts in the northern race; in the southern race it begins at a body length of 41 mm. The individuals of *Pseudosagitta gazellae* examined in the present work did not show any difference relating to the ovaries. The specimens taken north of the Antarctic Convergence belonged to maturity stage 1 with a length between 21.0 mm and 50.0 mm. The specimens netted in the Antarctic Ocean reached the same stage at 34.0–38.0 mm length. Subdivision into two races in these samples is not meaningful.

Only one species, *Solidosagitta marri,* is confined to antarctic waters. The maximum frequency of this species is in the Antarctic Ocean, though the northern limit is variable (David 1958).

HORIZONTAL DISTRIBUTION ALONG THE COAST OF NEW ZEALAND

For reasons of comparison only stations prefixed with "N" are taken into consideration in this section. These were all vertical hauls, taken with the same net type during December 1974 and January and February 1975. A total of 2055 chaetognaths belonging to 13 species were taken in these samples.

The New Zealand coast has been divided into six regions in terms of the currents:

1. Northeast coast of North Island from North Cape to East Cape. This region is influenced mainly by the East Auckland Current.
2. East coast from East Cape to Banks Peninsula excluding Cook Strait. Influenced by the Canterbury and East Cape Currents.
3. East coast of South Island from South Canterbury to Southland; Foveaux Strait and Stewart Island included. Influenced by the Southland Current.
4. West coast of South Island. This region is especially influenced by the Westland Current.
5. Tasman Bay, Golden Bay, South Taranaki coast, and Cook Strait. Influenced by the D'Urville Current.
6. West coast of North Island from North Cape to Cape Egmont. This region is influenced by the West Auckland Current and the Westland Current.

Figure 22 shows the stations and the depth of the hauls belonging to each region. The species found in the six regions are given in Fig. 23.

In region 1, 320 chaetognaths were taken averaging 22.9 individuals per station, belonging to nine species: *Pterosagitta draco, Krohnitta subtilis, Flaccisagitta hexaptera, Pseudosagitta lyra, Mesosagitta minima, Serratosagitta serratodentata, S. tasmanica, Solidosagitta zetesios,* and *Eukrohnia hamata.*

Region 2, with ~ 29.0 individuals per station, yielded 784 chaetognaths belonging to 10 species: *Pterosagitta draco, Krohnitta subtilis, Flaccisagitta hexaptera, Pseudosagitta lyra, P. gazellae, Mesosagitta minima, M. decipiens, Serratosagitta serratodentata, S. tasmanica,* and *Eukrohnia hamata.*

In region 3, 273 specimens were netted, averaging 18.2 individuals per station, belonging to five species: *Pterosagitta draco, Pseudosagitta lyra, Mesosagitta minima, M. decipiens,* and *Serratosagitta tasmanica.*

In region 4, only 8.8 individuals per station were taken. The 203 chaetognaths belonged to eight species: *Pterosagitta draco, Aidanosagitta regularis, Pseudosagitta lyra, Mesosagitta minima, M. decipiens, Serratosagitta serratodentata, S. tasmanica,* and *Eukrohnia hamata.*

Region 5 yielded 221 chaetognaths, averaging 12.2 individuals per station belonging to four species: *Pterosagitta draco, Mesosagitta minima, Serratosagitta serratodentata,* and *S. tasmanica.*

In region 6, 14.9 individuals per station were taken, totalling 254 chaetognaths belonging to nine species: *Pterosagitta draco, Flaccisagitta hexaptera, Pseudosagitta lyra, P. gazellae, Mesosagitta minima, Sagitta bipunctata, Serratosagitta serratodentata, S. tasmanica,* and *Eukrohnia hamata.*

The diversity of chaetognath species is equally high along the west and east coasts, but species composition is a little different. *Krohnitta subtilis* and *Solidosagitta zetesios* were found only on the east coast while *Aidanosagitta regularis* was found only on the west coast. Three species, *Pterosagitta draco, Mesosagitta minima,* and *Serratosagitta tasmanica,* were netted in all six coastal regions.

In region 5, only four species were taken. This is the lowest diversity, perhaps explained by the shallower depth. The number of chaetognath species and individuals is basically higher in the upper 200 m than below this depth (Alvariño 1965), and, within this zone, Thomson (1947) stated that the concentration between 25 m and 50 m is higher than at the surface.

In region 3 the reason for the low diversity could be the shallow depth but also the influence of the Subtropical Convergence. Only a few species approach or go beyond this faunistic barrier which lies around the southern part of South Island.

The average number of individuals per station is much higher on the east coast than on the west coast. The highest number of species and individuals was found in region 2. Probably this can be explained by the different conditions. The Canterbury Current is a cold current often mixed with subantarctic water by upwelling, and the warm East Cape Current flows in the opposite direction.

ACKNOWLEDGMENTS

Thanks are due to all those who provided material and gave encouragement to this work. Dr Dennis P. Gordon, N.Z. Oceanographic Institute; Prof. Dr Luitfried Salvini-Plawen, University of Vienna; Dipl. Biol. Helga Kapp, Dipl. Biol. Ellen Wahl, University of Hamburg; and Dr Günther Lutschinger (Vienna).

Region 6

Stn No.	Depth (m)
N367	25–0
N370	200–0
N371	200–0
N372	25–0
N373	50–0
N374	100–0
N375	200–0
N376	200–0
N378	50–0
N379	100–0
N380	200–0
N381	200–0
N382	25–0
N383	50–0
N384	100–0
N385	200–0
N386	200–0

Region 1

Stn No.	Depth (m)
N349	50–0
N350	100–0
N351	200–0
N352	200–0
N353	200–0
N355	40–0
N356	50–0
N357	100–0
N358	200–0
N359	180–0
N360	24–0
N361	50–0
N364	200–0
N365	200–0

Region 5

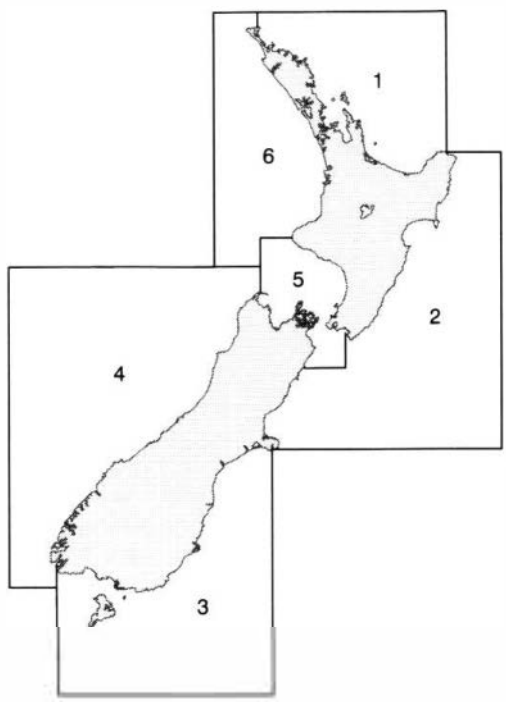
Stn No.	Depth (m)
N387	70–0
N388	50–0
N389	50–0
N395	60–0
N396	100–0
N397	40–0
N398	100–0
N399	25–0
N400	50–0
N401	100–0
N402	100–0
N416	22–0
N418	50–0
N419	90–0
N420	190–0
N421	100–0
N422	50–0
N423	25–0

Region 2

Stn No.	Depth (m)
N333	30–0
N334	50–0
N335	100–0
N336	200–0
N337	200–0
N338	25–0
N339	50–0
N340	100–0
N341	200–0
N342	200–0
N344	50–0
N345	100–0
N346	200–0
N347	200–0
N404	20–0
N405	50–0
N406	200–0
N407	200–0
N408	200–0
N411	100–0
N412	190–0
N413	200–0
N414	200–0
N415	200–0
N480	100–0
N481	200–0
N482	200–0

Region 4

Stn No.	Depth (m)
N428	25–0
N429	50–0
N430	100–0
N431	200–0
N432	200–0
N434	50–0
N435	100–0
N436	200–0
N438	200–0
N440	50–0
N441	100–0
N442	200–0
N445	176–0
N446	200–0
N447	120–0
N448	80–0
N449	200–0
N450	200–0
N453	200–0
N454	70–0
N456	170–0
N457	170–0
N458	200–0



Region 3

Stn No.	Depth (m)
N459	40–0
N460	38–0
N461	36–0
N462	28–0
N463	160–0
N464	160–0
N466	150–0
N467	90–0

Region 3 (cont.)

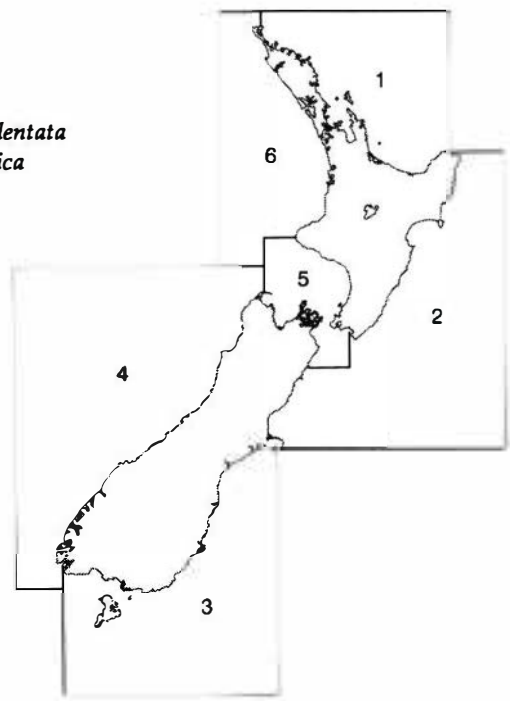
Stn No.	Depth (m)
N469	55–0
N470	100–0
N471	200–0
N472	25–0
N473	100–0
N474	100–0
N475	50–0

Fig. 22.
The six neritic regions of New Zealand,
listing the "N"-prefixed NZOI stations and depth of haul at which chaetognaths were taken in each region.

Region 6
Pterosagitta draco
Flaccisagitta hexaptera
Pseudosagitta lyra
Pseudosagitta gazellae
Mesosagitta minima
Sagitta bipunctata
Serratosagitta serratodentata
Serratosagitta tasmanica
Eukrohnia hamata

Region 1
Pterosagitta draco
Krohnitta subtilis
Flaccisagitta hexaptera
Pseudosagitta lyra
Mesosagitta minima
Serratosagitta serratodentata
Serratosagitta tasmanica
Solidosagitta zetesios
Eukrohnia hamata

Region 5
Pterosagitta draco
Mesosagitta minima
Serratosagitta serratodentata
Serratosagitta tasmanica



Region 2
Pterosagitta draco
Krohnitta subtilis
Flaccisagitta hexaptera
Pseudosagitta lyra
Pseudosagitta gazellae
Mesosagitta minima
Mesosagitta decipiens
Serratosagitta serratodentata
Serratosagitta tasmanica
Eukrohnia hamata

Region 4
Pterosagitta draco
Aidanosagitta regularis
Pseudosagitta lyra
Mesosagitta minima
Mesosagitta decipiens
Serratosagitta serratodentata
Serratosagitta tasmanica
Eukrohnia hamata

Region 3
Pterosagitta draco
Pseudosagitta lyra
Mesosagitta minima
Mesosagitta decipiens
Serratosagitta tasmanica

Fig. 23.
The six neritic regions of New Zealand and the chaetognath species taken at NZOI stations in each region.

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APPENDIX 1. *Pterosagitta draco*: Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	4.93	5.1
1	7.23	6.94
2	10.14	8.93
3	11.03	9.5

APPENDIX 2. *Pterosagitta draco*: Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	2	2	8.0–9.5	8.75
	3	1	10.0	10.0
A306	0	2	5.5–6.0	5.75
	1	23	5.5–9.5	6.81
	2	4	8.0–10.0	9.0
	3	4	8.0–11.0	9.37
A315	0	3	5.0–6.0	5.33
	1	3	7.0	7.0
	2	1	9.0	9.0
B67	0	28	4.5–66.0	5.03
	1	8	6.5–8.5	7.31
N336	3	1	10.0	10.0
N337	2	3	8.0–9.5	8.83
	3	4	10.0–11.0	10.62
N341	0	1	4.0	4.0
N346	0	1	4.0	4.0
N347	3	1	10.0	10.0
N351	3	1	10.0	10.0
N352	1	1	7.0	7.0
N353	0	1	6.0	6.0
	1	1	7.5	7.5
N358	1	1	6.5	6.5
	2	5	7.0–8.5	8.0
	3	4	9.0–16.0	13.75
N359	1	1	7.0	7.0
	2	3	8.0–10.0	8.66
	3	5	9.0–10.0	9.7
N364	1	5	7.0–7.5	7.2
	2	1	8.0	8.0
	3	1	11.5	11.5
N371	2	1	8.0	8.0
	3	2	10.0–14.0	12.0
N376	0	1	4.5	4.5
	1	1	5.5	5.5
	2	1	8.0	8.0

Appendix 2, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N376	3	3	10.5–11.5	10.83
N379	1	1	6.0	6.0
N381	1	2	6.0–7.0	6.5
	3	1	10.0	10.0
N384	0	1	5.0	5.0
N398	3	2	11.0–12.0	11.5
	1	3	7.0	7.0
	2	1	9.0	9.0
N401	0	1	5.5	5.5
N408	3	1	10.5	10.5
N436	3	1	10.5	10.5
N438	0	1	5.5	5.5
N442	1	1	6.0	6.0
N446	2	1	7.5	7.5
N473	2	1	9.0	9.0

APPENDIX 3. *Krohnitta subtilis*: Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	6.0	–
1	7.0	8.0
2	12.13	11.92
3	16.0	11.25

APPENDIX 4. *Krohnitta subtilis*: Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A306	1	1	8.0	8.0
	2	12	9.0–15.0	11.92
	3	2	11.0–11.5	11.25
N337	2	1	14.0	14.0
N346	0	1	6.0	6.0
	1	2	7.0	7.0
N353	2	1	13.0	13.0
	3	1	16.0	16.0
N364	2	1	12.0	12.0
N365	2	2	9.5–12.0	10.83

APPENDIX 5. *Aidanosagitta neglecta* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B78	2	1	6	6

APPENDIX 6. *Aidanosagitta regularis* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N435	2	1	8	8
	3	1	9.5	9.5

APPENDIX 7. *Ferosagitta robusta* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B78	0	41	3.5–6.0	4.76
	1	21	5.5–8.0	6.81
	2	3	11.0–13.0	12.0

APPENDIX 8. *Flaccisagitta hexaptera* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	–	10.7
1	21.17	19.21
2	38.75	–

APPENDIX 9. *Flaccisagitta hexaptera* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	0	1	11.0	11.0
A306	0	2	11.0–12.0	11.5
	1	4	16.0–21.0	18.75
B64	0	1	11.0	11.0

Appendix 9, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B67	0	1	8.5	8.5
	1	3	16.5–25.5	19.83
N345	2	1	45.0	45.0
N353	1	1	27.5	27.5
N358	1	1	20.0	20.0
N359	1	21	5.0–22.0	18.5
	2	2	35.0–40.0	37.5
N365	1	2	15.0–27.5	21.25
N370	2	1	35.0	35.0

APPENDIX 10. *Flaccisagitta enflata* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B78	0	16	6.0–8.0	7.59
	1	48	7.0–11.0	8.58
	2	72	7.0–14.5	10.28
B87	0	2	6.0–6.5	6.25
	1	2	8.0–8.5	8.25
	2	32	8.0–13.5	9.8

APPENDIX 11. *Pseudosagitta lyra* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	12.55	11.87
1	17.5	15.55
2	–	30.0

APPENDIX 12. *Pseudosagitta lyra* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	0	5	8.0–12.0	10.6
	1	1	25.0	25.0
A306	0	18	8.0–15.0	13.14
	1	19	13.0–22.0	16.55

Appendix 12, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A309	0	2	11.0–15.0	13.0
	1	9	15.0–24.0	19.11
	2	1	28.0	28.0
A310	0	13	7.0–11.0	9.38
	1	63	9.5–20.0	13.35
A311	0	1	11.0	11.0
A313	0	7	10.5–15.0	13.64
	1	15	16.0–23.0	18.66
	2	1	32.0	32.0
A315	0	2	12.0–14.0	13.0
	1	9	13.0–22.0	18.11
E774	1	2	17.0–23.0	20.0
N336	1	1	17.0	17.0
N341	1	2	13.0–26.5	19.75
N347	1	2	17.0–18.0	17.5
N364	1	1	18.0	18.0
N365	1	1	14.0	14.0
N370	1	1	14.5	14.5
N371	0	2	14.0–15.0	14.5
	1	3	17.0–20.0	18.33
N380	1	1	13.0	13.0
N381	1	4	12.5–28.0	20.5
N430	1	1	16.0	16.0
N436	1	1	14.0	14.0
N438	0	1	15.0	15.0
N449	0	2	10.0	10.0
	1	6	16.0–22.0	17.83
N458	0	1	12.0	12.0
N464	0	1	11.0	11.0
N466	1	1	17.0	17.0
N471	0	1	12.0	12.0
N481	0	1	14.0	14.0
N482	1	1	13.0	13.0

APPENDIX 13. *Pseudosagitta gazellae* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	14.5	14.64
1	27.25	29.54
2	–	56.0

APPENDIX 14. *Pseudosagittagazellae* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A309	1	3	23.0–31.0	28.33
	2	1	56.0	56.0
A310	1	6	21.0–35.0	24.5
A311	0	1	16.0	16.0
A313	0	3	12.5–21.0	16.83
	1	4	21.0–34.0	26.75
A315	0	3	11.0–20.0	16.33
	1	3	21.0–24.0	23.0
A454	0	1	18.0	18.0
	1	1	35.0	35.0
B31	0	2	18.0–27.0	22.5
	1	16	24.0–50.0	34.25
B99	0	1	18.0	18.0
B106	0	19	9.5–17.0	13.32
	1	3	22.0–23.5	22.83
B107	1	1	28.0	28.0
B113	0	1	13.0	13.0
B114	0	14	8.5	8.5
	1	2	34.0–38.0	36.0
B117	0	5	7.0–14.5	12.6
	1	1	24.0	24.0
B120	0	3	14.5–21.0	17.17
	1	1	37.0	37.0
B174	1	4	22.0–33.5	29.37
E761	1	1	45.0	45.0
E762	1	1	35.0	35.0
N370	1	1	26.0	26.0
N408	0	1	17.0	17.0
N411	1	1	31.0	31.0
N415	0	1	12.0	12.0
	1	1	23.0	23.0
N481	1	1	29.0	29.0

APPENDIX 15. *Pseudosagitta maxima* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	0	21	6.0–14.0	8.81
A306	0	6	10.0–16.0	12.58
A309	0	2	11.0–15.0	13.0
A313	0	7	12.0–24.0	17.43
A454	0	2	15.0–16.0	15.5
B28	0	1	8.0	8.0
B109	0	1	13.0	13.0

Appendix 15, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B114	0	2	25.0	25.0
B116	0	2	10.5–22.0	16.25
B119	0	2	9.0–12.5	10.75
B120	0	1	21.0	21.0

APPENDIX 16. *Mesosagitta minima* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	4.5	–
1	6.09	5.5
2	7.32	5.81
3	8.47	6.75
4	9.28	8.0

APPENDIX 17. *Mesosagitta minima* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	2	41	5.0–7.0	5.35
	3	3	5.5–7.0	6.33
A306	2	2	5.5–7.0	6.25
A315	1	1	5.5	5.5
	2	37	5.5–7.5	6.3
	3	11	6.0–7.5	6.86
	4	1	8.0	8.0
N333	2	7	7.0–9.0	8.0
	3	10	9.0–10.0	9.55
	4	1	11.0	11.0
N334	2	3	7.5–8.0	7.83
	3	3	8.5–9.5	9.0
	4	2	9.0–9.5	9.25
N335	2	5	7.0–8.5	7.6
	3	4	8.5–9.5	9.12
N336	1	4	7.0–8.5	7.62
	2	12	7.0–8.5	7.79
	3	3	9.0–9.5	9.17
	4	2	10.0	10.0
N337	0	1	4.0	4.0
	1	5	5.5–7.0	6.1

Appendix 17, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N337	2	4	7.0–8.5	7.5
N338	1	1	5.0	5.0
N339	2	6	6.5–9.0	7.42
N340	1	3	5.0	5.0
	2	126	5.0–8.5	6.82
	3	13	7.5–9.0	8.2
	4	4	8.5–9.5	8.87
N341	2	9	7.5–8.5	8.1
N342	1	2	5.5	5.5
	2	62	5.5–8.5	7.23
	3	5	8.0–8.5	8.4
	4	2	8.5–9.0	8.75
N344	2	1	7.5	7.5
N345	2	2	8.0	8.0
	3	1	9.0	9.0
N346	1	2	4.5–6.0	5.25
	2	16	5.5–8.5	7.09
	3	1	8.0	8.0
N347	1	7	4.5–7.5	6.0
	2	6	7.0–8.5	7.75
	3	5	8.5–9.0	8.6
N349	1	1	4.0	4.0
	2	6	6.0–8.0	7.0
N350	1	1	7.0	7.0
	2	29	6.0–8.5	7.48
	3	3	8.5–9.0	8.67
	4	3	8.5–9.0	8.83
N353	1	8	6.0–6.5	6.31
	2	30	6.5–8.0	7.05
	3	1	8.0	8.0
N355	2	2	7.0–7.5	7.25
N356	0	1	4.5	4.5
N357	1	3	5.0–5.5	5.33
	2	11	5.5–9.0	7.54
	3	1	8.5	8.5
N358	1	2	7.0–8.0	7.5
	2	35	7.5–8.5	7.93
	3	7	7.5–9.5	8.57
N359	2	8	7.0–8.0	7.37
	3	4	8.0–8.5	8.37
N360	2	2	8.0–8.5	8.25
N361	2	2	8.0	8.0
N364	2	12	7.5–8.0	7.75
	3	5	8.0–8.5	8.2
N365	1	7	6.0–6.5	6.28
	2	27	7.0–8.0	7.83
N367	2	3	8.0–9.0	8.5
N370	1	1	6.5	6.5

Appendix 17, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N370	2	18	6.5–8.0	7.38
	3	1	8.0	8.0
N371	2	5	7.0–7.5	7.3
N372	2	1	8.0	8.0
N373	2	1	7.0	7.0
N374	1	3	4.0–6.5	5.33
	2	2	7.0	7.0
	3	1	8.0	8.0
N375	1	3	4.5–5.5	4.83
	2	19	6.0–8.0	6.87
	3	2	8.0	8.0
N376	2	4	6.5–7.0	6.87
N378	1	1	4.5	4.5
	2	12	5.0–7.5	6.42
N379	1	2	6.0–7.0	6.5
	2	9	6.5–8.0	7.67
	3	4	8.0–8.5	8.37
N380	2	10	7.0–8.0	7.65
	3	5	7.5–9.0	8.4
N381	1	2	5.0–5.5	5.25
	2	18	6.0–8.0	6.8
	3	1	8.5	8.5
N382	2	1	6.0	6.0
N383	1	1	5.0	5.0
	2	3	6.5–7.0	6.83
N384	1	12	5.5–7.5	6.5
	2	18	6.5–8.5	7.53
	4	1	9.0	9.0
N385	2	2	7.0–8.0	7.5
N388	2	4	7.0–8.0	7.5
	3	4	8.0–9.0	8.5
	4	2	9.0	9.0
N395	2	1	8.0	8.0
N396	2	3	7.5–8.0	7.83
	3	5	8.0–9.0	8.5
	4	4	9.0	9.0
N397	2	5	7.5–9.0	8.3
N398	2	15	6.0–8.5	7.7
	3	5	7.5–9.0	8.3
	4	1	8.5	8.5
N399	2	1	7.5	7.5
N400	1	2	6.5–7.5	7.0
	2	13	6.5–8.0	7.42
	3	4	8.0–8.5	8.12
	4	2	8.0–9.0	8.5
N401	2	14	7.0–8.0	7.39
	4	2	9.0	9.0
N402	2	1	7.5	7.5

Appendix 17, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N402	3	1	8.5	8.5
N404	2	2	7.5	7.5
N405	3	1	8.5	8.5
N407	2	4	7.0–8.0	7.62
	3	1	8.0	8.0
	4	2	9.0	9.0
N408	2	2	7.0–7.5	7.25
	3	1	8.0	8.0
	4	1	8.0	8.0
N413	2	2	6.5–8.5	7.5
	3	3	8.0–9.0	8.67
N414	1	7	5.0–7.5	6.28
	2	42	5.5–8.5	7.33
N415	1	2	6.5	6.5
	2	29	6.5–8.5	7.45
	3	9	8.0–8.5	8.33
N416	2	1	7.5	7.5
N418	2	1	7.5	7.5
N419	2	1	7.5	7.5
N420	2	13	7.0–8.5	7.5
	3	4	8.0–9.0	8.37
N421	2	2	7.0–7.5	7.25
	3	2	8.0–8.5	8.25
N422	2	2	7.5–8.0	7.75
	3	5	7.5–8.0	7.9
N423	2	4	6.5–8.0	7.5
	3	6	7.0–8.5	7.92
N429	2	2	7.0–7.5	7.25
N430	2	4	6.0–8.0	7.25
N432	2	2	6.5	6.5
N434	2	2	7.5–8.0	7.75
N438	2	3	6.5	6.5
N440	2	1	7.0	7.0
N447	2	1	7.0	7.0
N449	2	1	6.5	6.5
N450	2	2	7.0–7.5	7.25
N457	2	1	7.5	7.5
	3	1	8.0	8.0
N459	2	2	8.5	8.5
N462	2	1	8.0	8.0
N469	3	1	8.5	8.5
N470	3	3	8.5–9.0	8.83
N471	2	1	7.5	7.5
N473	3	4	8.0–9.0	8.5
N474	3	2	8.0–8.5	8.25
	4	1	9.0	9.0

APPENDIX 18. *Mesosagitta decipiens* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	7.5	–
1	8.69	8.5
2	9.25	11.25
3	11.0	12.0
4	–	14.0

APPENDIX 19. *Mesosagitta decipiens* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A309	1	4	8.0–9.5	8.62
	2	2	10.5–12.0	11.25
	3	2	10.0–14.0	12.0
	4	1	14.0	14.0
A315	1	1	8.0	8.0
N346	1	2	8.0–8.5	8.25
	2	3	9.0	9.0
	3	1	12.0	12.0
N414	1	1	9.5	9.5
N415	3	1	10.0	10.0
N436	1	2	8.5–10.0	9.25
N446	0	3	7.0–8.0	7.5
	1	1	8.5	8.5
	2	1	10.0	10.0
N447	1	1	8.5	8.5
N462	1	1	8.0	8.0

APPENDIX 20. *Sagitta bipunctata*: Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	–	6.28
1	–	10.34
2	14.5	14.33
3	16.0	15.47
4	–	15.75

APPENDIX 21. *Sagitta bipunctata* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	1	3	10.0–12.0	10.67
	2	6	12.5–15.0	14.0
A306	1	1	11.0	11.0
	2	2	13.0–15.5	14.25
B33	0	1	7.0	7.0
B64	1	4	11.0–15.0	13.5
	2	6	15.0–16.0	15.33
	3	10	15.0–18.0	16.45
B65	0	2	8.5–10.5	9.5
	1	18	8.5–12.0	10.67
	2	9	13.0–17.0	15.11
B66	2	1	14.5	14.5
B67	0	4	7.0–9.5	8.5
	1	10	11.0–14.0	12.2
	2	24	10.5–15.5	14.27
	3	21	13.5–16.5	15.0
	4	6	15.0–17.0	15.75
B78	0	54	4.0–7.5	5.98
	1	15	7.0–9.0	7.77
	2	2	9.0–10.0	9.5
N371	2	1	14.5	14.5
	3	2	15.5–16.5	16.0

APPENDIX 22. *Serratosagitta pacifica* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B78	2	2	10.0	10.0

APPENDIX 23. *Serratosagitta serratodentata* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	–	5.7
1	9.43	7.49
2	10.34	8.82
3	11.41	9.47
4	–	12.0

APPENDIX 24. *Serratosagitta serratodentata* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A306	0	11	4.0–7.0	5.68
	1	13	6.5–8.5	7.04
	2	36	7.5–10.0	8.92
	3	3	10.0	10.0
A315	1	5	6.5–7.5	7.1
	2	10	7.5–9.5	8.25
A332	0	1	5.0	5.0
	1	2	7.0–7.5	7.25
	2	5	7.0–9.5	8.5
B27	4	1	12.0	12.0
B64	1	16	5.5–8.5	7.34
	2	49	7.5–10.0	9.04
	3	5	10.0–11.0	10.3
B65	1	2	8.5–9.5	9.0
	2	5	9.5–10.0	9.7
	3	2	10.0	10.0
B66	0	2	5.5–6.0	5.75
	1	56	6.0–9.0	7.63
	2	60	7.5–10.0	8.7
	3	14	9.0–10.5	9.71
B67	0	1	5.5	5.5
	1	6	6.0–8.5	7.25
	2	35	7.5–10.0	8.7
	3	9	8.5–10.0	9.33
	4	3	9.0–10.0	9.33
B78	0	2	6.0–6.5	6.25
	1	1	9.0	9.0
N337	3	1	12.5	12.5
N342	2	2	9.5–12.0	10.75
N347	2	1	8.5	8.5
N350	2	1	11.0	11.0
N358	1	6	7.5–11.0	9.75
	2	3	12.0	12.0
N359	2	28	9.5–12.0	10.86
	3	13	10.0–12.0	11.31
N365	2	2	10.0–10.5	10.25
	3	1	12.5	12.5
N370	2	2	10.0–10.5	10.25
	3	6	11.0–12.0	11.5
N371	2	5	9.5–11.0	10.2
	3	3	11.0–12.0	11.5
N372	2	1	7.5	7.5
N375	2	2	9.5–10.0	9.75
N376	2	5	9.0–10.5	9.9
N380	1	1	7.5	7.5
	2	3	9.0–9.5	9.33
	3	2	11.5	11.5
N381	2	3	7.5–9.5	8.83

Appendix 24, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N381	3	1	10.0	10.0
N388	3	1	11.0	11.0
N398	2	1	9.0	9.0
N436	2	1	9.0	9.0
N438	2	1	8.5	8.5

APPENDIX 25. *Serratosagitta tasmanica* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	5.71	6.65
1	7.24	7.81
2	10.99	8.54
3	13.57	11.33
4	19.75	–

APPENDIX 26. *Serratosagitta tasmanica* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A306	0	5	6.5–7.5	7.1
	1	1	8.0	8.0
	2	1	9.0	9.0
A307	0	1	7.5	7.5
	1	13	8.0–10.0	8.7
	2	40	8.0–11.5	9.62
A308	2	3	9.5–10.0	9.67
A309	0	1	8.0	8.0
	1	22	7.5–10.0	8.66
	2	8	8.5–10.5	9.44
A314	1	1	8.0	8.0
	2	17	8.0–12.0	10.59
A315	1	3	5.5–8.0	7.0
	2	5	8.0–9.0	8.4
A332	0	5	6.0–7.5	6.5
	1	73	6.0–9.0	7.49
	2	1566	7.0–10.5	8.39
B64	1	14	7.0–9.0	7.36
	2	76	7.5–10.5	9.41
	3	2	10.0–10.5	10.25

Appendix 26, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B65	1	37	7.5–9.0	8.49
	2	82	8.0–11.0	9.57
	3	6	10.0–11.0	10.42
B66	0	5	5.5–6.5	5.9
	1	44	6.0–9.0	7.23
	2	12	8.0–9.5	8.67
B67	1	21	7.5–8.5	7.86
	2	16	7.5–9.5	8.41
B120	3	1	14.0	14.0
B189	3	3	12.0–13.5	13.0
E709	2	4	8.5–10.5	9.62
N333	1	5	8.5–12.5	9.8
	2	3	11.0–12.5	11.83
	3	3	14.0–15.0	14.5
	4	1	10.0	20.0
N334	0	1	6.0	6.0
	1	3	6.5–8.0	7.17
	2	3	10.5–13.0	11.67
	3	1	13.5	13.5
N335	2	8	10.5–14.0	12.0
	3	3	11.5–14.0	12.83
N336	1	1	7.0	7.0
	2	7	10.0–15.0	12.5
	3	5	12.5–15.0	14.2
N332	2	2	11.0–11.5	11.25
N340	0	1	5.0	5.0
	1	8	6.5–8.0	7.37
	2	9	8.0–12.5	9.94
N342	1	2	6.5–7.5	7.0
	2	9	9.5–12.0	10.7
N360	2	1	11.0	11.0
N361	2	1	10.0	10.0
N370	2	1	12.5	12.5
	3	1	13.0	13.0
N375	2	5	10.0–12.0	10.8
N380	1	2	8.0–9.5	8.75
	2	5	8.5–11.0	9.7
	3	1	10.5	10.5
N384	2	1	11.0	11.0
N385	2	2	9.5–10.0	9.75
N386	2	2	10.0–11.5	10.75
N387	2	9	9.5–15.0	12.33
	3	1	14.0	14.0
N389	2	1	9.0	9.0
N396	1	1	7.0	7.0
	2	3	9.0–14.0	11.0
N397	2	1	8.5	8.5
N398	2	2	9.5–11.5	10.5

Appendix 26, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N400	1	1	7.5	7.5
N401	1	4	7.0–8.0	7.62
	2	22	8.5–13.0	10.86
N402	1	2	7.0–9.5	8.25
	2	15	11.0–13.0	11.97
N405	1	1	6.5	6.5
	2	1	8.0	8.0
N406	2	1	10.0	10.0
N407	1	1	7.5	7.5
	2	7	10.0–13.0	11.0
	3	4	12.5–13.0	12.87
N408	2	17	8.5–13.0	10.76
N411	1	2	7.0	7.0
	2	6	9.0–13.0	10.92
	3	1	13.0	13.0
N412	2	3	11.5–13.0	12.17
	3	1	15.0	15.0
N413	1	1	8.5	8.5
	2	14	8.5–11.5	10.25
N414	1	11	6.5–9.0	8.32
	2	11	9.0–11.0	10.23
	3	1	11.0	11.0
N415	1	4	8.0–9.0	8.5
	2	25	8.5–13.5	11.18
	3	2	12.0–14.0	13.0
N416	2	1	9.0	9.0
N418	2	2	10.0–11.5	10.75
N420	1	1	8.0	8.0
	2	18	9.5–13.0	11.72
	3	1	13.0	13.0
N421	3	2	12.0–14.0	13.0
N422	2	1	8.0	8.0
N423	2	1	9.5	9.5
N428	1	1	6.5	6.5
N429	2	7	11.5–15.0	12.64
N430	2	5	11.0–12.0	11.6
	3	1	13.0	13.0
N431	1	2	7.0–8.0	7.5
	2	2	8.5–12.5	10.5
N432	1	6	6.5–8.5	7.58
	2	8	8.0–10.0	9.25
N434	1	1	6.5	6.5
N435	2	4	10.0–12.5	11.62
N436	1	1	7.5	7.5
	2	11	9.0–13.0	10.36
	3	1	13.0	13.0
N438	1	4	6.0–7.0	6.75
	2	10	7.0–10.5	8.75

Appendix 26, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N438	3	1	12.0	12.0
N441	2	1	12.5	12.5
N442	1	1	7.5	7.5
	2	3	8.5–12.0	9.83
N445	1	1	7.0	7.0
N446	1	2	6.5–7.5	7.0
	2	1	8.5	8.5
N447	2	4	8.5–9.0	8.75
N448	0	2	5.0	5.0
	1	5	7.0–8.0	7.3
	2	6	9.0–11.5	9.67
N449	1	8	7.0–8.5	7.75
	2	8	8.5–10.0	9.25
N450	1	1	7.0	7.0
	2	12	8.0–11.0	10.0
N453	2	1	11.0	11.0
N454	1	1	7.5	7.5
	2	2	9.0–10.5	9.75
N456	0	3	6.0–6.5	6.33
	1	3	7.0–7.5	7.33
	2	5	10.0–12.0	11.0
	3	2	12.5–13.0	12.75
N457	1	3	7.0–8.0	7.5
	2	7	8.5–13.0	11.14
N458	1	1	7.0	7.0
	2	1	8.5	8.5
N459	2	11	11.0–13.0	11.91
N460	2	15	10.5–13.0	11.63
	3	2	13.5–14.0	13.75
N461	2	2	10.5–12.5	11.5
N463	1	5	8.0	8.0
	2	5	8.0–12.0	10.5
N464	2	10	9.0–13.0	11.45
	3	13	12.0–14.0	13.11
N466	2	9	10.5–12.5	11.55
	3	2	11.0–14.0	12.5
N467	1	1	9.0	9.0
	2	69	9.0–13.5	11.85
	3	9	12.5–14.0	13.22
N470	1	1	6.5	6.5
	2	18	8.0–12.5	10.05
N471	1	1	6.5	6.5
	2	15	8.0–13.0	10.43
N472	2	7	10.0–13.5	11.78
	4	1	19.5	19.5
N473	1	4	7.5–8.5	7.87
	2	12	10.0–13.0	11.83
	3	18	13.0–16.5	14.64

Appendix 26, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
N474	2	10	9.5–13.0	11.2
	3	4	14.0–18.0	15.12
N475	2	5	8.5–11.1	9.9
	3	1	12.0	12.0
N480	1	9	6.5–9.0	7.55
	2	38	7.5–12.5	10.41
	3	3	11.5–14.0	13.17
N481	2	11	9.0–14.0	11.36
N482	1	2	7.0–7.5	7.25
	2	19	8.5–13.5	11.58

APPENDIX 27. *Solidosagitta marri* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A454	1	2	9.0	9.0
	2	1	14.5	14.5

APPENDIX 28. *Solidosagitta zetesios* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	8.0	7.09

APPENDIX 29. *Solidosagitta zetesios* : Occurrenceat NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A305	0	17	4.0–10.0	6.12
A306	0	14	7.0–10.0	8.28
N365	0	1	8.0	8.0

APPENDIX 30. *Eukrohnia hamata* : Average body length according to preservation method.

Maturity	Formaldehyde (4%)	Alcohol (70%)
0	8.89	7.91
1	12.32	13.0
2	–	14.94

APPENDIX 31. *Eukrohnia hamata* : Occurrence at NZOI stations and numerical data.

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
A309	0	15	6.0–12.0	9.8
	1	24	10.0–18.0	14.33
A313	0	30	7.0–11.0	8.88
	1	7	10.0–15.0	11.93
A315	0	32	7.5–10.5	8.58
	1	3	9.0–13.0	10.5
A454	0	6	7.5–10.0	8.75
	1	67	9.0–21.5	14.1
A455	1	2	12.0–16.5	14.25
B31	1	4	15.0–15.5	15.12
B99	0	1	9.0	9.0
	1	2	13.0–13.5	13.25
B109	0	11	4.5–11.0	8.45
	1	6	11.0–15.0	12.58
B110	0	8	3.5–5.5	4.69
	1	14	8.0–12.5	10.86
	2	3	14.5–15.0	14.83
B111	0	11	7.0–15.0	10.95
	1	8	9.5–15.0	12.37
	2	5	15.0–18.5	16.1
B112	0	2	7.5–8.5	8.0
	1	7	10.0–12.0	10.93

Appendix 31, cont'd

Stn No.	Maturity	No. of indivs	Body length (mm)	Av. body length (mm)
B113	0	7	3.5–12.0	8.57
	1	4	11.0–13.0	12.0
B114	0	2	5.0	5.0
	1	9	10.0–13.5	12.0
	2	3	12.0–14.0	13.17
B116	0	10	5.5–13.5	9.5
	1	6	10.0–18.0	13.92
B117	0	17	4.0–12.0	6.98
	1	16	8.0–14.0	11.19
	2	1	16.0	16.0
B119	0	9	4.5–7.5	6.0
	1	5	8.0–13.0	10.8
	2	2	13.0–14.0	13.5
B120	0	2	10.0	10.0
	1	1	11.0	11.0
	2	1	18.0	18.0
E709	0	1	10.5	10.5
	1	11	11.0–15.0	12.91
	2	2	13.0–15.5	14.15
F753	0	1	9.0	9.0
N336	0	2	11.0–13.0	12.0
N345	0	2	5.0–12.0	8.5
N347	0	1	7.0	7.0
	1	1	11.5	11.5
N351	0	2	8.0	8.0
N375	1	2	10.5–11.0	10.75
N408	0	2	7.5–9.0	8.25
	1	3	11.0–14.0	12.17
N414	0	1	10.0	10.0
N415	0	2	9.0–10.0	9.5
	1	3	12.0–13.0	12.5
N446	0	2	7.0–8.0	7.5
	1	1	12.5	12.5
N481	1	1	16.0	16.0

INDEX