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## RECORDS OF DEEP-WATER CHAETOGNATHS FROM THE NORTHERN GULF OF MEXICO

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**ABSTRACT** Fourteen species of deep-water Chaetognatha were present in plankton samples collected between 200 and 677 m at five stations along the continental slope of the northern Gulf of Mexico. Samples were taken in conjunction with the MARFIN *Geryon* cruises of 1987 and 1988. New Gulf of Mexico records resulting from this study were *Eukrohnia calliops*, *Eukrohnia proboscidea*, *Mesosagitta sibogae*, and *Sagitta megalophthalma*. Other deep-water species present were *Eukrohnia fowleri*, *E. bathypelagica*, *E. bathyantartica*, *Caecosagitta macrocephala*, *Mesosagitta decipiens*, *M. minima*, *Solidosagitta planctonis*, *Krohnitta subtilis*, *Flaccisagitta hexaptera*, and *F. lyra*. In addition, the normally epipelagic taxa, *Pterosagitta draco*, *Serratosagitta serratodentata*, and *Sagitta bipunctata* occurred in some of the samples.

### INTRODUCTION

Mesoplanktonic (those occurring between 200 and 1000 meters) and bathyplanktonic species of Chaetognatha (those occurring below 1000 meters) are mostly cosmopolitan in nature, being associated with and transported about by specific undersea currents. Although the coastal epipelagic chaetognath fauna of the northern Gulf of Mexico has been well documented (Pierce 1951, 1962; McLelland 1984), the deeper offshore species remain poorly known because of the difficulty and expense of gathering material for study. An opportunity to study deep-water chaetognaths recently arose when plankton samples were collected over the continental slope in the northern Gulf of Mexico as part of an effort to provide data on the distribution of larvae of the deep-water crabs, *Geryon fenneri* and *G. quinquegens*. This paper provides documentation of deep-water chaetognath species in the northern Gulf of Mexico by recording the presence and relative abundance of 14 mesoplanktonic and bathyplanktonic taxa found in samples collected below 200 meters. In addition, three epipelagic (0-200 m) species also occurred in the samples.

### MATERIALS AND METHODS

Plankton samples were collected at five sampling areas along the continental slope of the northern Gulf of Mexico (Figure 1) during the MARFIN *Geryon* cruises of 1987 and 1988. Closing nets (1 m, 333  $\mu$ m mesh) equipped with Niskin double-trip devices were towed between 200 and 500 m to sample the water column above the crab traps. In addition, 0.3 m, 183  $\mu$ m mesh nets designed to passively filter the

current for 24 hours were attached to crab trap arrays resting on the bottom at 677 m.

Catch data indicating distribution and relative abundance of chaetognath species caught during the *Geryon* cruises and hydrographic data collected near the bottom of the water column are presented in Table 1. Chaetognaths were removed, identified to species, and counted from a total of 32 samples, 27 towed and five bottom net. In some cases, numbers of specimens were estimated because of large, unmanageable sample volumes and damaged specimens.

### RESULTS AND DISCUSSION

The bottom nets, being smaller in diameter and stationary, filtered less water and thus captured fewer numbers of chaetognaths than the towed nets; however, they usually produced samples with a greater diversity of species than towed samples from the same areas.

Of the 14 deep-water species recorded, six were present in at least 22 of the 32 samples analyzed: *Mesosagitta sibogae* (30 samples), *Krohnitta subtilis* (29 samples), *Flaccisagitta hexaptera* (29 samples), *F. lyra* (24 samples), *F. decipiens* (24 samples), and *M. minima* (22 samples). Of these, *M. sibogae* was most often the dominant species, with *K. subtilis* second and *F. lyra* third in abundance.

*Eukrohnia bathypelagica*, present at all five sampling areas (14 samples), was the most common of the five *Eukrohnia* species present, while the two rarest, *E. bathyantartica* and *E. proboscidea*, occurred only once, in the same sample at Area 5.

Three normally epipelagic species, *Sagitta bipunctata*, *Pterosagitta draco*, and *Serratosagitta serratodentata*, occurred sporadically in the samples,

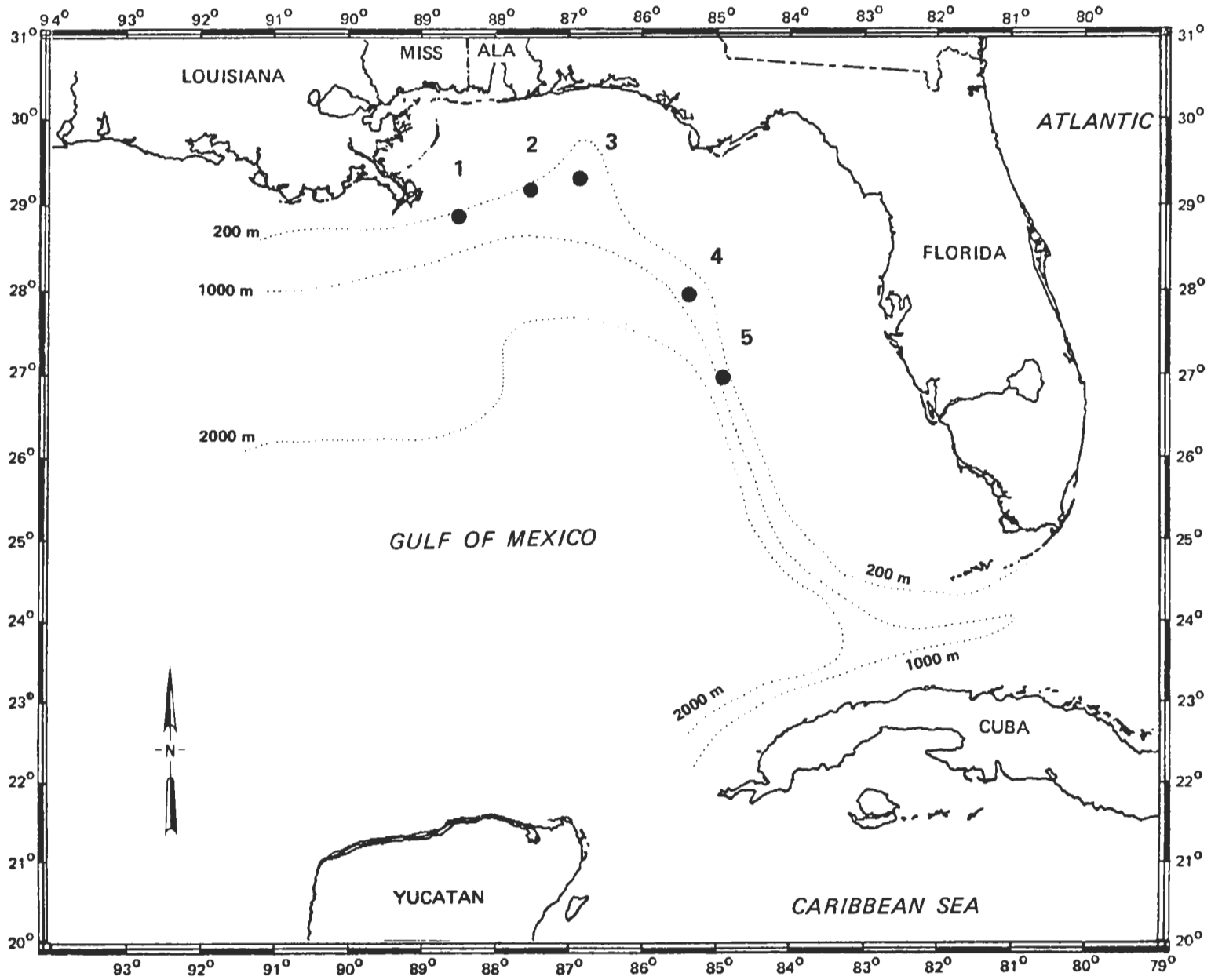


Figure 1. Locations of MARFIN - *Geryon* sampling areas in the Gulf of Mexico.

TABLE 1

Station and Hydrographic Data for the MARFIN-Geryon deep-water plankton collections in the northern Gulf of Mexico and the relative abundance of chaetognaths in the samples

Station	Position	Date	Time	Bot- tom dpth (m)	Sam- pling dpth (m)	Tow- ing tm (min)	Bot- tom sal (ppt)	Bot- tom temp (°C)	Chaetognath specimens per sample																	
									Ec	Ef	Ep	Ebp	Eba	Cm	Ms	Md	Mm	Sm	Sp	Ks	Fh	Fl	Sb	Pd	Ss	
Area 1	29°02'N 88°27'W	8/2/87	0941	677	200-500	55	36.0	8.4	-	-	-	-	-	-	>50	-	>10	-	-	>10	>10	>50	-	<10	<10	
			2007	494	200-400*	33	36.0	8.4	3	-	-	-	-	-	-	-	-	-	-	-	<10	-	<10	-	-	-
		12/17/87	1715	677	200-500	82	38.0	6.5	-	-	-	1	-	1	33	11	9	-	-	11	12	6	-	-	-	1
			0909	494	200-400	55	37.0	8.0	-	-	-	-	-	-	+	+	+	-	1	+	+	-	-	-	-	+
			1147	677	200-500	75	36.0	6.5	-	-	-	-	-	-	2	1	2	-	-	-	2	-	-	-	-	-
1930	677	677**	25hr	36.0	6.5	2	-	-	1	-	4	4	4	6	-	-	6	2	1	-	13	9	-	-		
Area 2	29°18'N 87°34'W	8/4/87	1640	677	200-500	54	38.0	8.6	-	-	-	3	-	-	>50	<10	<10	-	-	>50	>50	>10	<10	-	-	
			1910	494	200-400*	44	38.0	8.6	131	-	-	-	-	-	-	>50	1	-	-	18	25	7	-	-	1	
		12/2/87	1012	677	200-500	53	36.0	6.2	-	-	-	9	-	-	50	>25	>30	-	1	73	12	18	-	-	8	
			1035	677	200-500	30	34.0	6.3	5	-	-	-	-	-	23	10	-	5	1	11	-	7	-	1	3	
		2002	494	200-400	58	35.0	8.8	-	-	-	-	-	-	-	1	-	2	-	-	2	2	-	-	3	2	
2/14/88	0730	677	677**	23hr	34.0	6.3	5	-	-	2	-	-	5	2	8	-	-	4	2	8	-	4	-	-		
Area 3	29°21'N 86°57'W	8/6/87	0838	677	200-500	54	39.0	6.4	13	2	-	3	-	-	>50	7	>10	-	-	>50	<10	>50	-	-	<10	
			1710	677	200-500	55	38.0	8.0	-	-	-	-	-	-	>100	<10	>25	-	-	>100	44	4	-	-	5	
		2/16/88	1317	494	200-400	58	36.0	7.7	-	-	-	3	-	2	-	34	+	-	-	+	-	+	-	-	+	
			1919	677	200-500	94	36.0	6.7	2	3	-	10	-	3	10	6	2	-	1	3	1	4	-	-	5	
		2/17/88	1840	677	677**	25hr	36.0	6.7	7	-	-	2	-	-	5	2	>10	-	-	4	2	8	-	4	>10	
Area 4	27°54'N 85°16'W	8/8/87	1150	494	200-400	31	38.0	7.7	1	-	-	-	-	-	35	1	6	-	-	23	7	16	-	2	2	
			1533	677	200-500	44	38.0	7.7	-	-	-	-	-	-	>50	<10	<10	-	-	>10	>10	>50	-	-	<10	
		12/7/87	0012	677	200-500	36	37.0	9.4	-	3	-	9	-	-	51	43	20	-	1	20	12	25	-	-	-	
			0915	677	200-500	82	38.0	6.5	-	-	-	1	-	-	8	2	-	-	-	3	2	4	-	-	2	
		2/25/88	1432	494	200-400	46	38.0	8.4	-	-	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	
			2219	494	200-400	41	38.0	8.4	-	-	-	-	-	-	+	-	-	-	-	+	+	+	-	-	+	
			2345	494	400-485	27	38.0	8.4	1	-	-	1	-	-	+	+	-	-	1	+	+	+	-	-	+	
2/26/88	1910	677	677**	24hr	38.0	6.5	3	-	-	-	-	-	1	-	5	-	-	6	1	-	1	6	3			
Area 5	27°00'N 84°57'W	8/10/87	1609	494	200-400	34	38.0	8.6	-	-	-	-	-	<10	<10	>50	-	-	>50	>10	-	-	2	1		
			2146	677	200-500	45	38.0	6.4	-	-	-	4	-	-	38	3	7	-	-	16	9	39	-	-		
		12/11/87	1633	677	200-500	102	37.0	6.8	-	-	-	2	-	-	67	44	14	-	1	99	12	22	-	-	-	
			1649	677	200-500	73	38.0	6.6	-	-	-	-	-	-	8	-	-	-	-	1	2	3	-	-	3	
		2/24/88	0720	677	677**	24hr	38.0	6.6	-	4	1	-	1	3	2	2	1	-	-	2	1	-	-	3	9	
		3/20/88	0017	494	200-400	-	NT	NT	-	-	-	-	-	-	+	-	-	-	-	-	+	-	+	+	+	
		3/21/88	0212	677	200-500	-	NT	NT	-	-	-	-	-	-	+	-	-	-	1	+	+	+	+	+	+	

\* net accidentally dragged bottom

\*\* 0.3 m nets attached to crab traps, passive samples

NT = not taken

+ = present but not counted

Ec = *Eukrohnia calliops*Eba = *Eukrohnia bathyantarctica*Mm = *Mesosagitta minima*Fh = *Flaccisagitta hexaptera*Ss = *Serratosagitta serratodentata*Ef = *Eukrohnia fowleri*Cm = *Caecosagitta macrocephala*Sm = *Sagitta megalophthalma*Fl = *Flaccisagitta lyra*Ep = *Eukrohnia proboscidea*MS = *Mesosagitta sibogae*Sp = *Solidosagitta planctonis*Sb = *Sagitta bipunctata*Ebp = *Eukrohnia bathypelagica*Md = *Mesosagitta decipiens*Ks = *Krohnitta subtilis*Pd = *Pterosagitta draco*

with the latter being the most common (24 samples). Their presence in the samples probably indicated either mixing of epipelagic water into the upper reaches of the sampled strata (200–500 m) or contamination of samples with material from upper waters. The bottom nets, which were continuously open, naturally captured a few specimens of epiplanktonic fauna during deployment and retrieval.

Four of the species obtained in this study, *Eukrohnia calliops*, *E. proboscidea*, *Mesosagitta sibogae*, and *Sagitta megalophthalma*, constitute new records for the Gulf of Mexico. The following list displays synonyms and selected descriptive references for the 14 deep-water and three epiplanktonic species found in the samples. See McLelland (1989b) for distribution records, ecological notes, meristic counts, and brief descriptions of these and other species occurring in the Gulf of Mexico.

#### *EUKROHNI*A *CALLIOPS* McLelland

*E. calliops* McLelland, 1989a (Figs. 2, 3, 4A, 5A,B)  
*E. calliops*, McLelland 1989b (Figs. 2A–D).

#### *EUKROHNI*A *FOWLERI* Ritter-Zahony

*E. fowleri* Ritter-Zahony, 1909.  
*E. fowleri*, Ritter-Zahony 1911a (Figs. 43,45); David 1958 (Figs. 2b, 3a,d); Colman 1959; Alvaríño 1962 (Figs. 19b,e; 21c,d), 1967 (Figs. 3,4), 1969 (Figs. 36,37); Ducret 1965 (Figs. 3c, 4d, 5–7); Furnestín 1965 (Figs. 4–6); Every 1968 (Pl. 2); Fagetti 1968; Silas and Srinivasan 1968 (Fig. 7G–K); Boltovskoy 1981 (Fig. 256/3); Kassatkina 1982 (Fig. 38B,C); Michel 1984 (Fig. 11); McLelland 1989a (Figs. 4D; 5G,H), 1989b (Figs. 3A–F).

#### *EUKROHNI*A *PROBOSCIDEA* Furnestín and Ducret

*E. proboscidea* Furnestín and Ducret, 1965 (Fig. 1).  
*E. proboscidea*, Ducret 1965 (Figs. 3d, 4c, 9–12), 1975 (PL. 4B); Owre 1973; Michel 1984 (Figs. 13–15); Casanova 1986; McLelland 1989a (Figs. 4C; 5E,F), 1989b (Figs. 2E–G).

#### *EUKROHNI*A *BATHYPELAGICA* Alvaríño

*E. bathypelagica* Alvaríño, 1962 (Figs. 18; 19c,d,f,g; 20)  
*E. bathypelagica*, Alvaríño 1967 (Figs. 1,2), 1969 (Figs. 34,35); Ducret 1965 (Figs. 3b, 4b, 8); Silas and Srinivasan 1968 (Figs. 1M, 2E–H); Owre 1973; Boltovskoy 1981 (Fig. 256/2); Kassatkina 1982 (Fig. 35); Michel 1984 (Fig. 10); Casanova 1986 (Fig. 4d,e); McLelland 1989b.

#### *EUKROHNI*A *BATHYANTARCTICA* David

*E. bathyantartica* David, 1958 (Figs. 2a, 3b,c)  
*E. bathyantartica*, Fagetti 1968 (Fig. 1); Alvaríño 1969 (Figs. 32,33); Owre 1972, 1973 (Fig. 3); Boltovskoy 1981 (Fig. 256/1); Michel 1984 (Fig. 9); McLelland 1989b.

#### *CAECOSAGITTA* *MACROCEPHALA* (Fowler) Tokioka

*Sagitta macrocephala* Fowler, 1905  
*S. macrocephala*, Ritter-Zahony 1911a (Figs. 37,38); Colman 1959; Alvaríño 1967 (Figs. 28,29), 1969 (Figs. 75,76); Every 1968 (Pl. 7B); Boltovskoy 1981 (Fig. 256/15); Michel 1984 (Figs. 28,29).  
*C. macrocephala*, Tokioka 1965; Kassatkina 1982 (Fig. 70A–C); McLelland 1989b (Figs. 6A–B).

#### *MESOSAGITTA* *SIBOGAE* (Fowler) Tokioka

*Sagitta sibogae* Fowler, 1906 (Pl. 2, Figs. 66–72).  
*S. sibogae*, Pierrot-Bults 1979 (Figs. 1b, 5,6)  
*S. decipiens*, Alvaríño 1967 (Figs. 38,39), 1969 (Figs. 87,88);  
*M. sibogae*, McLelland 1989b (Figs. 8B,C; 12F).

#### *MESOSAGITTA* *DECIPIENS* (Fowler) Tokioka

*Sagitta decipiens* Fowler, 1905 (Pl. 5, Figs. 32–35)  
*S. decipiens*, Pierrot-Bults 1979 (Figs. 1a, 2–4); Boltovskoy 1981 (Fig. 256/8a); Michel 1984 (Fig. 19)  
*M. decipiens*, Tokioka 1965; McLelland 1989b (Figs. 8A, 12E).

#### *MESOSAGITTA* *MINIMA* (Grassi) Tokioka

*Sagitta minima* Grassi, 1881  
*S. minima*, Ritter-Zahony 1911a (Figs. 27–29); Almeida-Prado 1961 (Figs. 10,12,14,15); Alvaríño 1967 (Figs. 37,37), 1969 (Figs. 85,86); Every 1968 (Pl. 8); Boltovskoy 1981 (Fig. 256/18); Michel 1984 (Fig. 34).  
*M. minima*, Tokioka 1965; Kotori and Kobayashi 1979 (Figs. 5A,B); Kassatkina 1982 (Fig. 55); McLelland 1989b (Figs. 8D, 12D).

#### *SAGITTA* *MEGALOPHTHALMA* Dallot and Ducret

*S. megalophthalma* Dallot and Ducret, 1969 (Figs. 1,2).  
*S. megalophthalma*, Dallot 1970 (Figs. 5d, 7a); Michel 1984 (Figs. 30–33); McLelland 1989b (Figs. 10A–C).

**SOLIDOSAGITTA PLANCTONIS** (Steinhaus) Tokioka

- Sagitta planctonis* Steinhaus, 1896  
*S. zetesios* Fowler, 1905  
*S. zetesios*, Colman 1959; Alvaríño 1967 (Figs. 30,31), 1969 (Figs. 81,82); Dallot 1970 (Figs. 1-3, 5a, 7f); Boltovskoy 1981 (Fig. 256/23).  
*S. planctonis* forma *zetesios*, Pierrot-Bults 1975; Michel 1984 (Figs. 3,36).  
*Solidosagitta zetesios*, Tokioka 1965; Kassatkina 1982 (Fig. 57)  
*S. planctonis*, McLelland 1989b (Figs. 10D-F).

**KROHNITTA SUBTILIS** (Grassl) Ritter-Zahony

- Sagitta subtilis* Grassl, 1881  
*K. subtilis*, Ritter-Zahony 1911a (Figs. 49-51); Vannucci and Hosoe 1952 (PL. 3, figs. 5,6; PL. 4, figs. 7,8); Suárez-Caabro 1955 (Pl. 7, Figs. A-E); Suárez-Caabro and Madruga 1960 (Fig. 3B); Colman 1959; Vega-Rodriguez 1965 (Fig. 8); Alvaríño 1967 (Figs. 9,10), 1969 (Figs. 42,43); Every 1968 (Pl. 1A); Boltovskoy 1981 (Fig. 256/6); Michel 1984 (Figs. 4,41); McLelland 1989b (Figs. 5A-D).

**FLACCISAGITTA HEXAPTERA** (d'Orbigny) Tokioka

- Sagitta hexaptera* d'Orbigny, 1843 (Figs. 4,5)  
*S. hexaptera*, Ritter-Zahony 1911a (Fig. 1), 1911b (Figs. 6,7); Vannucci and Hosoe 1952 (PL. 1, fig.4; PL. 2, figs. 2-4); Suárez-Caabro 1955 (Pl. 1, Figs. A-E); Colman 1959; Vega-Rodriguez 1965 (Figs. 3A,B); Alvaríño 1967 (Figs. 15,16), 1969 (Figs. 54,55); Every 1968 (Pl. 5); Boltovskoy 1981 (Fig. 256/12); Michel 1984 (Fig. 25).  
*Flaccisagitta hexaptera*, Tokioka 1965; Kassatkina 1982 (Fig. 91); Thuesen and Bieri 1987 (Figs. 1-9); McLelland 1989b (Figs. 7B,C; 12A).

**FLACCISAGITTA LYRA** (Krohn) Tokioka

- Sagitta lyra* Krohn, 1853  
*S. lyra*, Ritter-Zahony 1911a (Figs. 3,8), 1911b (Fig. 8); Colman 1959; Alvaríño 1967 (Figs. 13,14), 1969 (Figs. 50,5); Every 1968 (Pl. 3A); Silas and Srinivasan 1968 (Fig. 7A-F); Boltovskoy 1981 (Fig. 256/14); Michel 1984 (Fig. 27).  
*Flaccisagitta lyra*, Tokioka 1965; Kassatkina 1982 (Fig. 91); McLelland 1989b (Figs. 7D,E; 12B).

**PTEROSAGITTA DRACO** (Krohn) Costa

- Sagitta draco* Krohn, 1853  
*P. mediterranea*, Costa 1869

- Spadella draco*, Fowler 1906, Michael 1911 (PL. 2, fig. 10; PL. 3, fig. 23; PL. 4, fig. 37).  
*P. besnardi*, Vannucci and Hosoe 1952 (PL. 4, figs. 1-5).  
*P. draco*, Ritter-Zahony 1911a (Fig. 40), 1911b (Fig. 15); Suárez-Caabro 1955 (Pl. 9, Figs. A-F); Colman 1959; Suárez-Caabro and Madruga 1960 (Fig. 3D); Vega-Rodriguez 1965 (Fig. 10); Alvaríño 1967 (Figs. 11,12), 1969 (Figs. 44,45); Boltovskoy 1981 (Fig. 252g); Kassatkina 1982 (Fig. 39); Michel 1984 (Fig. 5); McLelland 1989b (Figs. 4, 12H).

**SAGITTA BIPUNCTATA** Quoy and Gaimard

- S. bipunctata* Quoy and Gaimard, 1827 (PL. 8C, figs. 2-6).  
*S. bipunctata*, Ritter-Zahony 1911a (Fig. 15), 1911b (Fig. 11); Vannucci and Hosoe 1952 (PL. 1, figs. 1-3; PL. 2, fig. 1); Suárez-Caabro 1955 (Pl. 3, Figs. A-E); Colman 1959; Vega-Rodriguez 1965 (Figs. 5A,B); Alvaríño 1969 (Figs. 71,72); Kassatkina 1982 (Fig. 84); Boltovskoy 1981 (Figs. 256/7a,b) Michel 1984 (Fig. 18); McLelland 1989b (Figs. 9, 12I).

**SERRATOSAGITTA SERRATODENTATA** (Krohn) Tokioka

- Sagitta serrato-dentata* Krohn, 1853 (Figs 3,4)  
*S. serratodentata*, Ritter-Zahony 1911a (Figs. 21,22), 1911b (Fig. 13); Vannucci and Hosoe 1952 (PL. 3, figs. 1-5); Suárez-Caabro 1955 (Pl. 4, Figs. A-E); Colman 1959; Suárez-Caabro and Madruga 1960 (Fig. 2C); Vega-Rodriguez 1965 (Figs. 6A-C); Alvaríño 1967, 1969 (Figs. 61,62); Boltovskoy 1981 (Fig. 256/20a-c); Michel 1984 (Figs. 37,38).  
*S. serratodentata* subspecies *serratodentata*, Pierrot-Bults 1974 (Fig. 3).  
*Serratosagitta serratodentata*, Tokioka 1965; McLelland 1989b (Figs. 11A-D).

Considering worldwide and Atlantic distribution synopses published by Alvaríño (1965, 1969) and others, the species of Chaetognatha occurring in Gulf of Mexico waters as listed by McLelland (1989b) can be loosely grouped into depth categories which may vary according to location, water conditions, time of day, maturity stage, etc. They are arranged below within such categories in order of increasing vertical distribution:

**Epiplanktonic (0-200 m)**

- Sagitta tenuis*  
*Sagitta friderici*  
*Sagitta helenae*  
*Ferosagitta hispida*

*Flaccisagitta enflata*  
*Krohnitta pacifica*  
*Serratosagitta serratodentata*  
*Pterosagitta draco*  
*Sagitta bipunctata*

*Eukrohnia hamata*  
*Eukrohnia bathyantartica*  
*Bathobelos typhlops*

#### Lower epiplanktonic – Upper mesoplanktonic

*Flaccisagitta hexaptera*  
*Mesosagitta minima*  
*Krohnitta subtilis*

#### Mesoplanktonic (200–1000 m)

*Flaccisagitta lyra*  
*Mesosagitta sibogae*  
*Mesosagitta decipiens*  
*Sagitta megalophthalma*  
*Solidosagitta planctonis*

#### Lower mesoplanktonic – bathyplanktonic (below 1000 m)

*Eukrohnia calliops*  
*Eukrohnia fowleri*  
*Eukrohnia proboscidea*  
*Eukrohnia bathypelagica*  
*Caecosagitta macrocephala*

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