

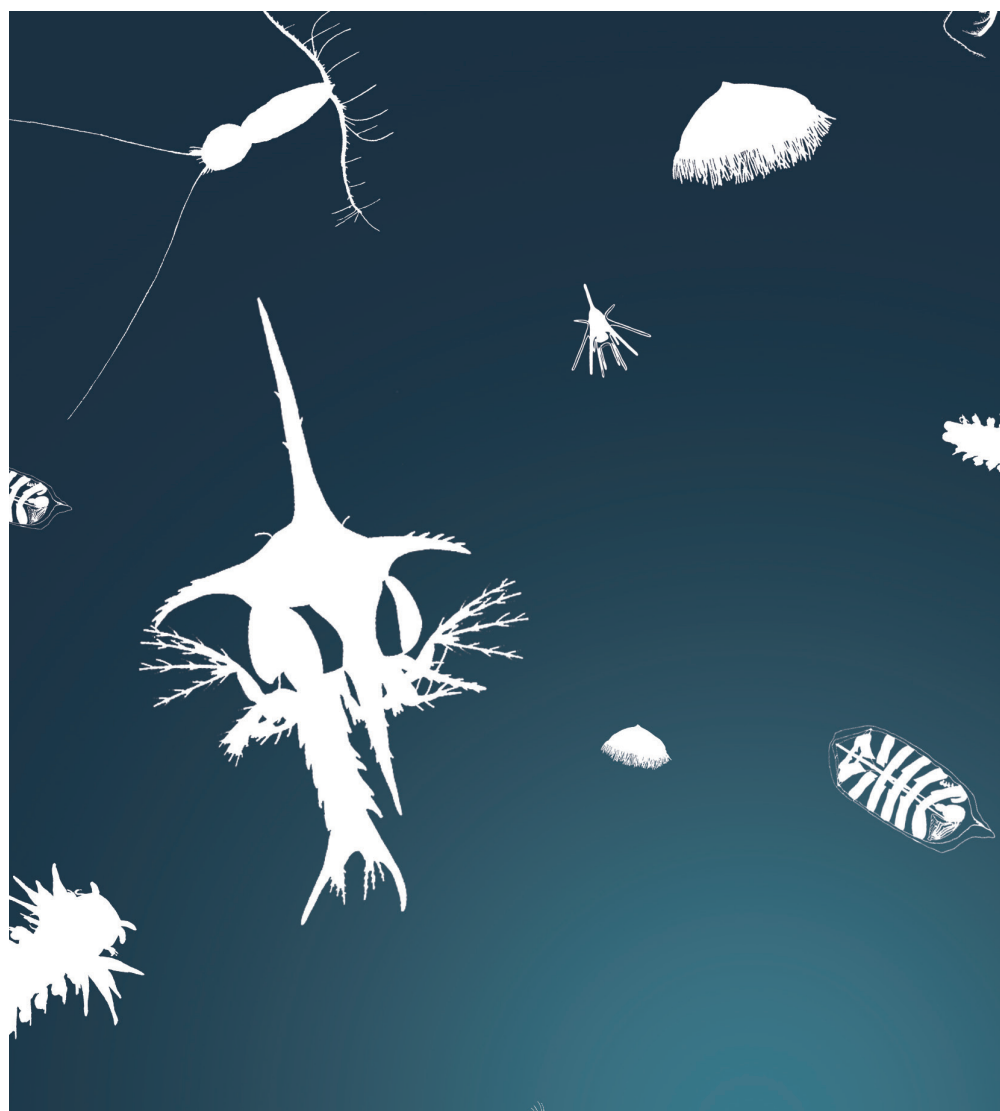
Chaetognatha

Annelies C. Pierrot-Bults

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**ICES IDENTIFICATION
LEAFLETS FOR PLANKTON**

**FICHES D'IDENTIFICATION
DU ZOOPLANCTON**



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Chaetognatha

Order: Phragmophora and Apheragmophora

Genera: *Eukrohnia*, *Krohnitta*, *Pterosagitta*, and *Sagitta*

1 Summary

There are currently two recognized orders of chaetognaths: (i) Phragmophora, with the planktonic genera *Eukrohnia*, and *Heterokrohnia*; the benthoplanktonic genus *Archeterokrohnia*; and the benthic genera *Spadella*, *Paraspadella*, *Hemispadella*, *Calispadella*, *Bathyspadella*, and *Xenokrohnia*; and (ii) Apheragmophora, with the planktonic genera *Krohnitta*, *Pterosagitta* and *Sagitta*. In this leaflet, the genus *Sagitta* is not divided into several genera. This taxonomic division is based on revisions by Ritter-Zahony (1911) and Tokioka (1956). More recent information can be found in Bone et al. (1991), Casanova (1999), and Pierrot-Bults (2017).

This is a major revision of ICES Identification Leaflets for Plankton No. 1 (Fraser, 1939; revised by Fraser, 1957). It covers the 28 of the 41 planktonic species recognized in the ICES Area. Excluded are 12 species of the very deep living genus *Heterokrohnia* and *Sagitta abyssicola*, all occurring below approximately 2000 m.

2 Introduction

Chaetognaths are strictly marine, and are traditionally considered to be carnivorous, or in deeper layers, detritivorous. In laboratory experiments, they feed mainly on copepods. To catch their prey, they dart suddenly over short distances, hence their common name "arrow worms" (Reeve, 1964; Feigenbaum, 1992). Field studies revealed substantial prey loss of more than 50% in the guts of sampled chaetognaths in tows of longer than 2 minutes duration (Baier and Purcell, 1997). However, recent publications have argued that chaetognaths are mainly osmotrophic, feeding by gulping water through their guts, since the majority of sampled chaetognaths are found without food in their guts (Duvert *et al.*, 2000; Casanova *et al.*, 2012). The main predators of chaetognaths are fish.

Two orders of chaetognaths are recognized. However, earlier morphological research has shown that the order Phragmophora, with the genera *Spadella*, *Paraspadella*, *Hemispadella*, *Calispadella*, *Bathyspadella*, and *Xenokrohnia*, the benthoplanktonic *Archeterokrohnia* and the planktonic *Eukrohnia* and *Heterokrohnia*, is paraphyletic; while the order Apheragmophora, with the planktonic genera *Pterosagitta*, *Krohnitta*, and *Sagitta* is monophyletic (Casanova and Duvert, 2002). This conclusion is supported by more recent molecular research (Gasmi *et al.*, 2014), which indicated that the diversity of Chaetognatha is the result of mosaic evolution. Moreover, chaetognaths have mostly evolved by simplification of their body plan, and their history shows numerous convergent events of losses and reversions.

At present, approximately 120 species are recognized. However, recent molecular studies have revealed groupings within species (Peijnenburg *et al.*, 2006; Miyamoto *et al.*, 2010, 2012), indicating that cryptic species may exist. Around 70 species are planktonic. Forty-one pelagic species are recorded in ICES area. Of these, 12 species belonging to the genus *Heterokrohnia* (*H. angeli*, *H. biscayensis*, *H. curvichaeta*, *H. davidi*, *H. discoveryi*, *H. furnestinae*, *H. heterodonta*, *H.*

involucrum, *H. mirabilis*, *H. mirabiloides*, *H. murina*, and *H. rubra*), and *Sagitta abyssicola* are not covered in this leaflet, since they mainly occur below approximately 2000 m. Furthermore, in this leaflet, the genus *Sagitta* is not subdivided into several genera suggested by Bieri (1991), pending further investigations (the new genus names can be viewed in the link to WoRMS in Section 7).

Chaetognaths are bilateral symmetric, protandric hermaphrodites. Adult length varies between ca. 2–140 mm, depending on the species. They have a head, a trunk, and a tail section. The head presents characteristic hooks or bristles, and one or two rows of teeth. Most species have a characteristically shaped eye pigment. One or two pairs of lateral fins are present, plus a tail fin. The testes are situated in the tail section, with seminal vesicles on either side of the tail. The ovaries are situated in the trunk, with the genital openings near the tail septum. Cross-fertilization is believed to be the rule. Sperm packages are deposited on the trunk of another individual, and sperm passes through the genital openings in the seminal receptacles alongside the ovaries until required for fertilization. The black spots in *Pterosagitta draco* (Figure 6) and *Sagitta lyra* (Figure 10) are sperm clusters. The fertilized eggs are released in the water, with the exception of a few species of deep-sea *Eukrohnia* that have brood sacs protruding from the genital openings (Figure 4 shows remnants of brood sacs). Chaetognaths have no true larval stage, although the early juvenile stages have one pair of posterior lateral fins and no anterior fins (Kotori, 1975).

Chaetognath growth and life cycles are largely regulated by temperature. In polar waters, there is a one to two year life cycle, while in temperate waters a spring and an autumn brood are typically produced. In (sub)tropical waters, breeding can occur several times a year (McLaren, 1963). Maximum length varies, since growth stops once the temperature for spawning is reached. In temperate waters, the spring cohort is typically longer than the autumn one, the latter having grown under higher temperatures. When the right spawning temperatures are not reached, the specimens remain sterile and may grow to greater lengths than normal.

For a comprehensive overview of Chaetognatha, see Bone *et al.* (1991).

3 Distribution

Chaetognaths occur in the epipelagic (0–200 m), shallow mesopelagic (200–500 m), deep mesopelagic (500–1000 m), and bathypelagic layers (> 1000 m). They are most abundant in the epipelagic.

Of the 28 pelagic species described in this leaflet, 4 are neritic, i.e. occurring above the continental shelf (*Sagitta setosa*, *S. friderici*, *S. helenae*, and *S. hispida*); 1 is distant neritic in (sub)arctic waters (*S. elegans*); 1 is distant neritic, associated with oxygen-poor water in the eastern Pacific and eastern Atlantic (*S. bierii*); and 21 species are oceanic.

The highest diversity of chaetognaths is found in the stratified subtropical layers of the central gyres. In neritic waters, such as the North Sea, only one or two species are usually found, while in neighbouring oceanic waters, around 20 species can be present. Neritic species show restricted distributions, e.g. they can differ on either side of an ocean, while oceanic species occupy large geographical areas. The ICES Area species covered by this leaflet are listed below.

Most species occupy specific vertical layers in the stratified (sub)tropical layers (Pierrot-Bults, 1982). However, some widespread species, e.g. *Eukrohnia hamata*, *Sagitta zetesios*, and *S. maxima*, which occur from ca. 70°N–70°S are deep mesopelagic in latitudes 40°N–40°S in stratified

waters, while at higher latitudes where mixing occurs, they can be found throughout the water column. This is called tropical submergence.

<i>Eukrohnia bathyantartica</i>	Deep-mesopelagic to bathypelagic; described from Antarctic waters, distributed with Antarctic Intermediate Waters to the northwestern Atlantic, and probably coming through the Charlie-Gibbs Fracture Zone in the Mid-Atlantic Ridge to the northeastern Atlantic (Pierrot-Bults, 2008).
<i>Eukrohnia bathypelagica</i>	Deep-mesopelagic; recorded in all oceans.
<i>Eukrohnia fowleri</i>	Deep-mesopelagic; recorded in all oceans.
<i>Eukrohnia hamata</i>	Deep-mesopelagic in all oceans from ca. 40°N to 40°S, but throughout the whole water column at higher latitudes, tropical submergence.
<i>Eukrohnia macroneura</i>	Deep-mesopelagic and bathypelagic; recorded in the Atlantic.
<i>Krohnitta mutabbii</i>	Described from (sub)tropical western Atlantic waters (Alvariño, 1969); but also found in the Sargasso Sea (Pierrot-Bults and Nair, 2004). Usually synonymized as <i>K. pacifica</i> .
<i>Krohnitta subtilis</i>	Epipelagic to shallow-mesopelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Pterosagitta draco</i>	Epipelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta bierii</i>	Distant-neritic in the eastern Atlantic and eastern Pacific; associated with oxygen-poor waters.
<i>Sagitta bipunctata</i>	Epipelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta decipiens</i>	Deep-mesopelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta elegans</i>	Distant-neritic; recorded in (sub)Arctic waters.
<i>Sagitta enflata</i>	Epipelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta friderici</i>	Neritic; recorded on narrow shelves in the northeastern Atlantic and Mediterranean Sea.
<i>Sagitta helenae</i>	Distant-neritic epipelagic; recorded in the western Atlantic from 35°N to 30°S.
<i>Sagitta hexaptera</i>	Shallow-mesopelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta hispida</i>	Distant-neritic epipelagic; recorded in the western Atlantic from 35°N to 30°S.
<i>Sagitta lyra</i>	Shallow-mesopelagic; recorded in all oceans from ca. 40°N to 40°S.

<i>Sagitta macrocephala</i>	Bathypelagic; recorded in all oceans, including the Arctic and Antarctic.
<i>Sagitta maxima</i>	Deep-mesopelagic to bathypelagic, in all oceans from ca. 40°N to 40°S, but throughout the whole water column at higher latitudes, tropical submergence.
<i>Sagitta minima</i>	Epipelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta planctonis</i>	Shallow-mesopelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta serratodentata</i>	Epipelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta setosa</i>	Neritic; recorded on wide shelves in the North Atlantic, North Sea, and Mediterranean and Black Sea; disjunct distribution.
<i>Sagitta sibogae</i>	Shallow-mesopelagic; recorded in all oceans from ca. 40°N to 40°S.
<i>Sagitta tasmanica</i>	Epipelagic, recorded in transitional waters in the North Atlantic and transitional waters in all oceans in the southern Hemisphere.
<i>Sagitta tenuis</i>	Distant-neritic epipelagic; recorded in the western Atlantic from 35°N to 30°S, and equatorially in the eastern Atlantic.
<i>Sagitta zetesios</i>	Deep-mesopelagic in all oceans from ca. 40°N to 40°S, but throughout the whole water column at higher latitudes, tropical submergence.

4 Main diagnostic features to distinguish chaetognath species

1. Presence or absence of transversal musculature.
2. Presence or absence of teeth rows.
3. Presence of one or two pairs of lateral fins; shape and position of lateral fins.
4. Presence or absence of gut diverticula (Fig.1)
5. Shape of seminal vesicles (Fig. 1)
6. Position of seminal vesicles in relation to the tail fin and the lateral fins.
7. Length of ovaries.
8. Shape of eye pigment.
9. Length of tail section relative to total length.
10. Total length in adults.

5 Taxonomic Key

The following is a key for species identification in the ICES Area. For a more elaborate key, including *Archeterokrohnia*, and *Heterokrohnia*, see Casanova (1999).

- | | | |
|---------|--|----------------------------|
| I. | Transversal musculature present..... | Phragmophora |
| I.a. | One long fin on trunk and tail; one row of posterior teeth..... | <i>Eukrohnia</i> |
| 1. | Diamond-shaped eye pigment (Figure 2a)..... | <i>E. fowleri</i> |
| 2. | No eye pigment, but if stained with methylene blue: | |
| 2.a. | Completely stained eye spot (Figure 2b)..... | <i>E. hamata</i> |
| 2.b. | Eye spot with some granulates (Figure 2c)..... | <i>E. bathypelagica</i> |
| 2.c. | Eye spot colourless in centre (Figure 2d)..... | <i>E. bathantarcica</i> |
| 2.d. | No eyes (Figure 5)..... | <i>E. macroneura</i> |
| II. | Transversal musculature absent | Aphragmophora |
| II.a. | One fin on tail section; AT and PT; huge collarette..... | <i>Pterosagitta</i> |
| | | <i>P. draco</i> |
| II.b. | One short fin on trunk and tail; one row of long AT..... | <i>Krohnitta</i> |
| 1. | Lateral fin almost without fin rays..... | <i>K. subtilis</i> |
| 2. | Lateral fin with fin rays..... | <i>K. mutabbi</i> |
| II.c. | Two pairs of lateral fins; AT and PT..... | <i>Sagitta</i> |
| 1. | AF and PF with fin bridge | |
| 1.a. | Body flaccid; no collarette | |
| 1.a.i. | Max TL 90 mm; tail 19–25% of TL..... | <i>S. maxima</i> |
| 1.a.ii. | Max TL 42 mm; tail 15–17% of TL..... | <i>S. lyra</i> |
| 1.b. | Body muscular; collarette present | |
| 1.b.i. | Max TL 37 mm; tail 19–21% of TL; PT 10–14 | <i>S. planctonis</i> |
| 1.b.ii. | Max TL 45 mm; tail 20–23% of TL; PT 15–22 | <i>S. zetesios</i> |
| 2. | AF and PF separate; hooks serrated; body needle like; SV with knob and trunk | |
| 2.a. | Max TL 13 mm; two appendages on SV knob; PT 12–20 (Figure 3a)..... | <i>S. serratodentata</i> |

- 2.b.** Max TL 30 mm; protuberances on SV knob; PT 9–15
(Figure 3b)..... *S. tasmanica*
- 2.c.** Max TL 19 mm; SV knob with one protuberance
(Figure 3c)..... *S. bierii*
- 3.** AF and PF separate; hooks not serrated
- 3.a.** SV round or ovoid (Figure 1)
- 3.a.i.** Max TL 70 mm; tail 16–20% of TL; body flaccid; AF very
short, partially rayed; SV touching TF, away from PF;
long OV..... *S. hexaptera*
- 3.a.ii.** Max TL 25 mm; tail 14–17% of TL; body flaccid; AF very
short, partially rayed; SV touching TF, away from PF; very
short OV..... *S. enflata*
- 3.a.iii.** Max TL 22 mm; tail 29–34% of TL; body muscular; big
head; no eye pigment; SV touching neither PF nor TF
..... *S. macrocephala*
- 3.a.iv.** Max TL 30 mm; body firm; fins fully rayed; SV away
from PF, close to tail fin; GD very small..... *S. elegans*
- 3.b.** SV with knob and trunk (Figure 1)
- 3.b.i.** Max TL 10 mm; body flaccid; small head; SV touching
TF, away from PF; very short OV; few large eggs
..... *S. minima*
- 3.b.ii.** Max TL 14 mm; body flaccid; small head; short AF; OV
short; no collarette; SV close to or touching both PF and
TF..... *S. setosa*
- 3.b.iii.** Max TL 15 mm; body firm; head narrow; AF Medium
length; SV close to or touching both PF and TF *S. friderici*
- 3.b.iv.** Max TL 19 mm; body muscular; broad head; collarette
absent or short; SV touching TF..... *S. bipunctata*
- 3.b.v.** Max TL 11 mm; body slender; small head; collarette
short; SV touching both PF and TF; short
OV..... *S. tenuis*
- 3.b.vi.** Max TL 14 mm; body slender; collarette short; broad
head; SV touching both PF and TF; OV medium length
..... *S. helenae*
- 3.b.vii.** Max TL 11 mm; body flaccid; broad head; long
collarette; SV touching PF away from TF; OV medium
length..... *S. hispida*

- 3.c. Pronounced gut diverticula; big eyes with large T-shaped pigment spot
- 3.c.i. Max TL 30 mm; body slender; medium length ovaries; pronounced SV touching TF, away from PF... *S. sibogae*
- 3.c.ii. Max TL 14 mm; body slender; short AF; SV midway between PF and TF; short OV..... *S. decipiens*

6 Figures

All figures are from the author of the current leaflet. Figures 4-3, 4-5 and 4-8 are redrawn from Alvariño, 1962; Casanova, 1986; and Alvariño, 1969; respectively.

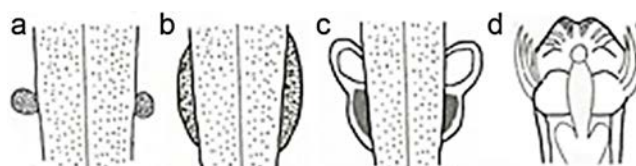


Figure 1. Seminal vesicles and gut. a: SV round; b: SV ovoid; c: SV knob and trunk, and d: gut diverticula. Drawings not to scale.

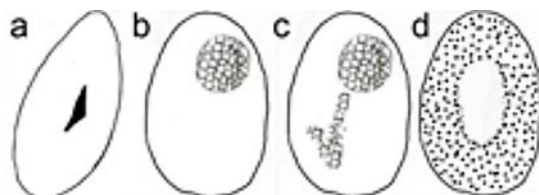


Figure 2. Eyes. a: *E. fowleri*; b: *E. hamata*; c: *E. bathypelagica*; and d: *E. bathyantartica*. Drawings not to scale.

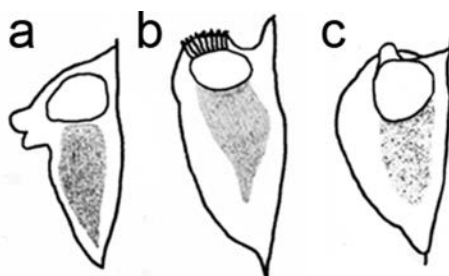


Figure 3. Seminal vesicles (SV). a: *S. serratodentata*; b: *S. tasmanica*; and c: *S. bierii*. Drawings not to scale.

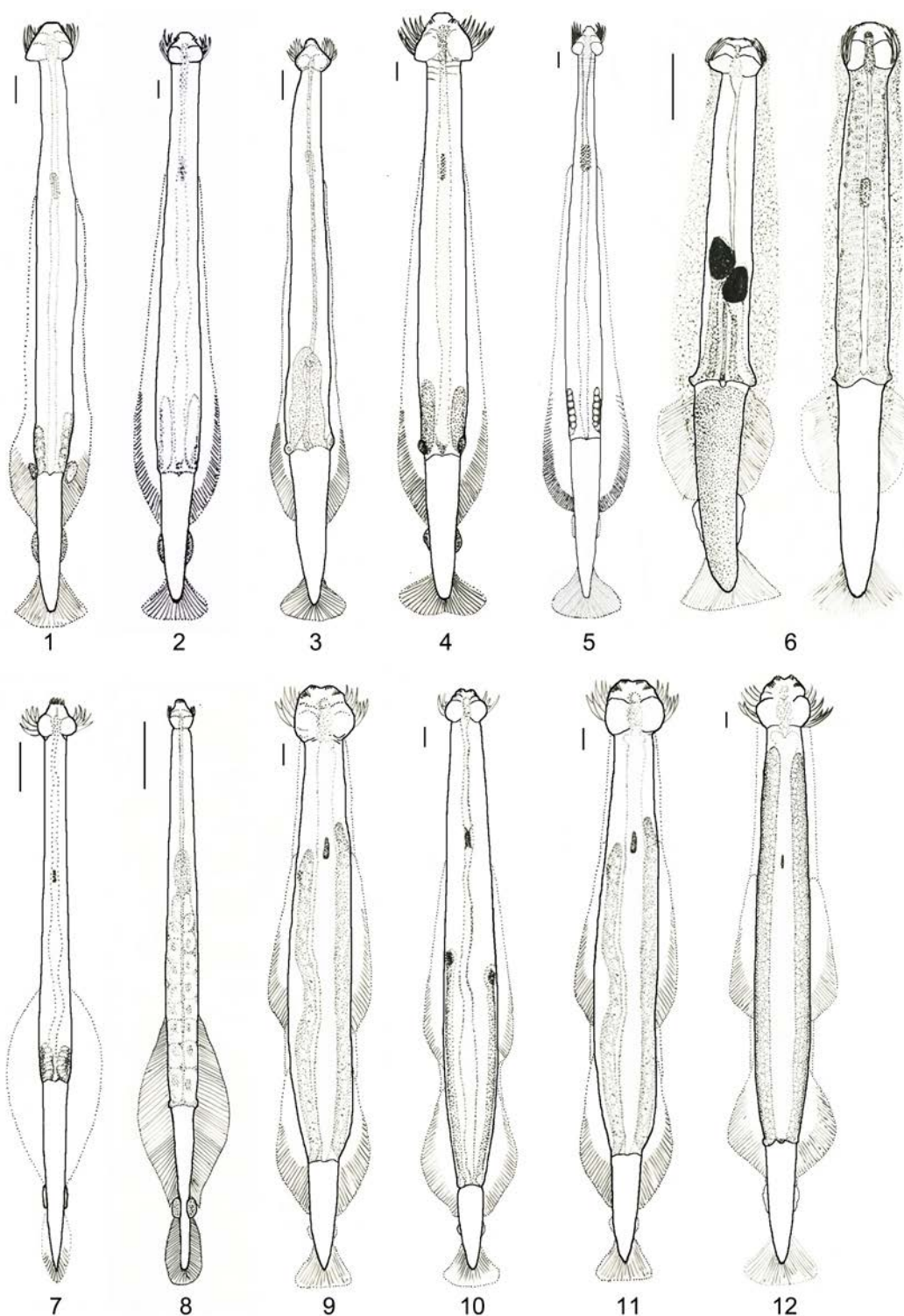


Figure 4. Ventral view of the general morphology of the Chaetognatha – 1: *Eukrohnia fowleri*; 2: *E. hamata*; 3: *E. bathypelagica*; 4: *E. bathyantartica*; 5: *E. macroneura*; 6: *Pterosagitta draco*; 7: *Krohnitta subtilis*; 8: *K. mutabbii*; 9: *Sagitta maxima*; 10: *S. lyra*; 11: *S. planctonis*; and 12: *S. zetesios*. Drawings not to scale. Figures redrawn from Alvariño 1962 (3); Casanova 1986 (5); and Alvariño 1969 (8).

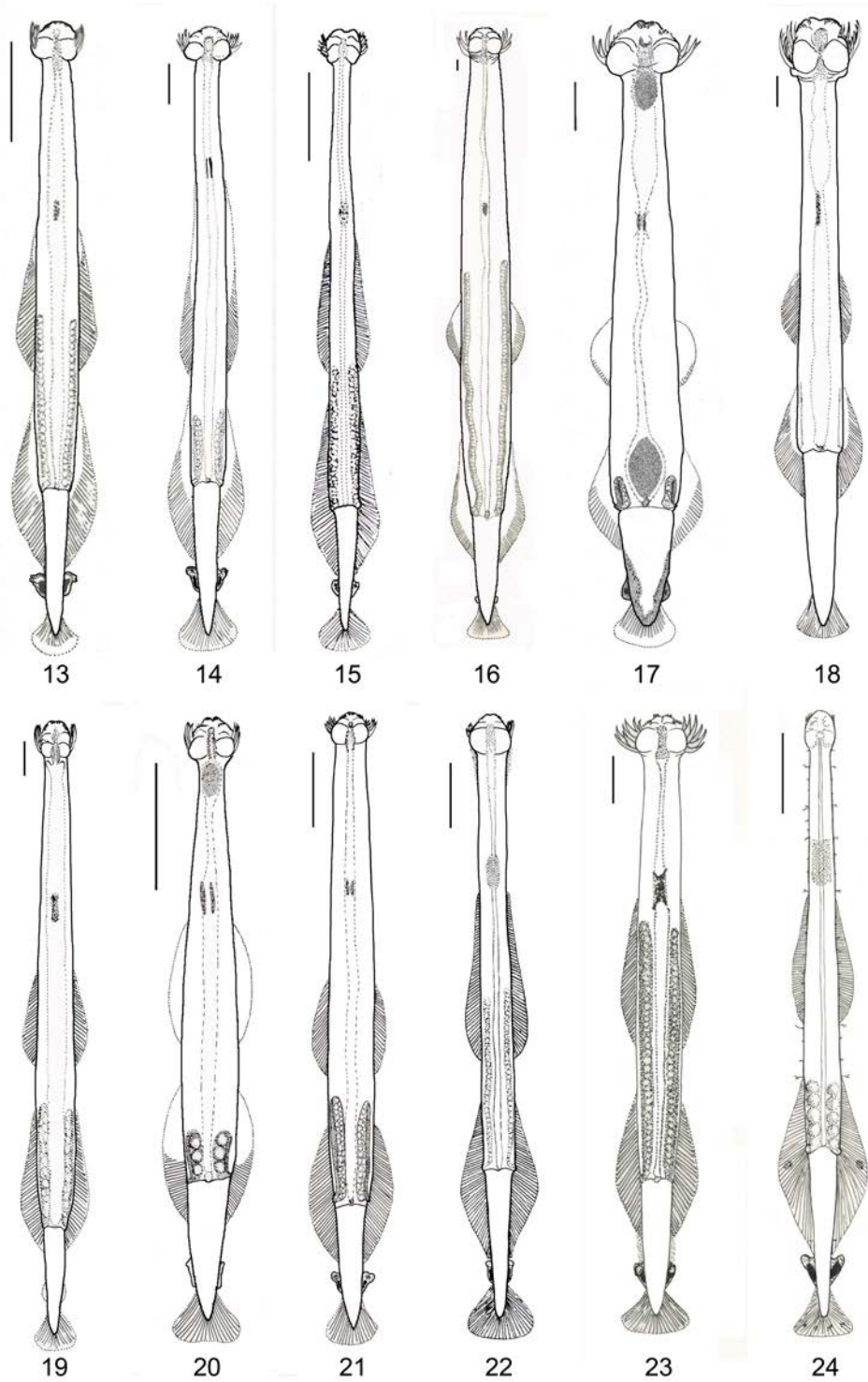


Figure 5. Ventral view of the general morphology of the Chaetognatha. 13: *S. serratodentata*; 14: *S. tasmanica*; 15: *S. bierii*; 16: *S. hexaptera*; 17: *S. enflata*; 18: *S. macrocephala*; 19: *S. elegans*; 20: *S. minima*; 21: *S. setosa*; 22: *S. friderici*; 23: *S. bipunctata*; and 24: *S. tenuis*.

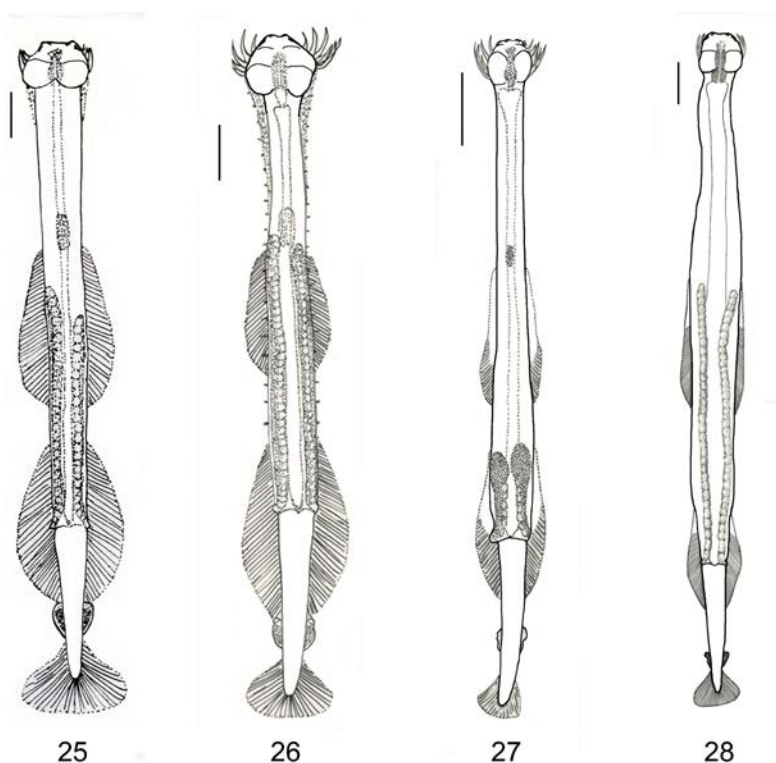


Figure 6. Ventral view of the general morphology of the Chaetognatha. 25: *S. helenae*; 26: *S. hispida*; 27: *Sagitta decipiens*; and 28: *S. sibogae*.

7 Links to further information

WoRMS

Chaetognatha	https://www.marinespecies.org/aphia.php?p=taxdetails&id=2081
<i>Eukrohnia bathyantartica</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=266224
<i>Eukrohnia bathypelagica</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105414
<i>Eukrohnia fowleri</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105415
<i>Eukrohnia hamata</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105416
<i>Eukrohnia macroneura</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=266229
<i>Krohnitta mutabbii</i> as <i>K. pacifica</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=266239

<i>Krohnitta subtilis</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105429
<i>Pterosagitta draco</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105430
<i>Sagitta bierii</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=237827
<i>Sagitta bipunctata</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105405
<i>Sagitta decipiens</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105405
<i>Sagitta elegans</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105450
<i>Sagitta enflata</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105451
<i>Sagitta friderici</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105452
<i>Sagitta helenae</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=266262
<i>Sagitta hexaptera</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105453
<i>Sagitta hispida</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105454
<i>Sagitta lyra</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105455
<i>Sagitta macrocephala</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105456
<i>Sagitta maxima</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105457
<i>Sagitta minima</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105458
<i>Sagitta planctonis</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105459
<i>Sagitta serratodentata</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105460
<i>Sagitta setosa</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=154107
<i>Sagitta sibogae</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=870414
<i>Sagitta tasmanica</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105461
<i>Sagitta tenuis</i>	http://www.marinespecies.org/aphia.php?p=taxdetails&id=268039
<i>Sagitta zetesios</i> (as <i>Solidosagitta</i> <i>zetesios</i>)	http://www.marinespecies.org/aphia.php?p=taxdetails&id=105463

Molecular information

Molecular research on several chaetognath species showed that DNA barcoding analysis was highly successful; resolved the species in accordance with morphological traits, and demonstrated relationships between sister species (Jennings *et al.*, 2010; Nair *et al.*, 2015).

Molecular information is available for 21 out of the 28 species described in this leaflet. The information is available from different sources, e.g. cytochrome c oxidase, mitochondrial, and 28S.

<i>Eukrohnia bathyantartica</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368383
<i>Eukrohnia bathypelagica</i>	https://www.ncbi.nlm.nih.gov/nuccore/DQ351896
<i>Eukrohnia fowleri</i>	https://www.ncbi.nlm.nih.gov/nuccore/DQ351889
<i>Eukrohnia hamata</i>	https://www.ncbi.nlm.nih.gov/nuccore/DQ351887
<i>Eukrohnia macroneura</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368393
<i>Krohnitta mutabbii</i>	No information available
<i>Krohnitta subtilis</i>	https://www.ncbi.nlm.nih.gov/nuccore/KM519928
<i>Pterosagitta draco</i>	https://www.ncbi.nlm.nih.gov/nuccore/KU507531
<i>Sagitta bierii</i>	No information available
<i>Sagitta bipunctata</i>	https://www.ncbi.nlm.nih.gov/nuccore/AP011546
<i>Sagitta decipiens</i>	https://www.ncbi.nlm.nih.gov/nuccore/AP011546
<i>Sagitta elegans</i>	https://www.ncbi.nlm.nih.gov/nuccore/AY942691
<i>Sagitta enflata</i>	https://www.ncbi.nlm.nih.gov/nuccore/KX009873
<i>Sagitta friderici</i>	No information available
<i>Sagitta helenae</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368404
<i>Sagitta hexaptera</i>	https://www.ncbi.nlm.nih.gov/nuccore/MH649355
<i>Sagitta hispida</i>	No information available
<i>Sagitta lyra</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368407
<i>Sagitta macrocephala</i>	https://www.ncbi.nlm.nih.gov/nuccore/Z77128
<i>Sagitta maxima</i>	https://www.ncbi.nlm.nih.gov/nuccore/Z77118
<i>Sagitta minima</i>	No information available

<i>Sagitta planctonis</i> as <i>Solidosagitta planctonis</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368417
<i>Sagitta serratodentata</i>	https://www.ncbi.nlm.nih.gov/nuccore/Z77119
<i>Sagitta setosa</i>	https://www.ncbi.nlm.nih.gov/nuccore/DQ486120
<i>Sagitta sibogae</i> as <i>Decipisagitta sibogae</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368421
<i>Sagitta tasmanica</i>	No information available
<i>Sagitta tenuis</i>	No information available
<i>Sagitta zetesios</i>	https://www.ncbi.nlm.nih.gov/nuccore/GQ368425

Other useful links

Pierrot-Bults, A.C. 2004. Chaetognatha of the world. Available at: www.species-identification.org/about.php.

Copepedia: <http://copepedia.org/?id=T4000017>.

8 Abbreviations and Terminology

Abbreviations

TL	Total length	TF	Tail fin
AT	Anterior teeth	SV	Seminal vesicles
PT	Posterior teeth	OV	Ovaries
AF	Anterior fin	GD	Gut diverticula
PF	Posterior fin		

Terminology

Collarette: Loose tissue in the neck region outside the body wall. It can be short, as seen in *Sagitta friderici* and *S. helenae* (figures 5.22 and 6.25); it can reach to the anterior fins, as seen in *S. zetesios* (Figure 3.12); or it can be very long and elaborate, as seen in *Pterosagitta draco* (Figure 3.6).

Distant neritic: Distribution reaches across the ocean, and is not confined to waters above the continental shelf.

Gut diverticula: A bulge in the gut just below the head section. Examples can be seen in *Sagitta decipiens* and *Sagitta sibogae* (figures 6.27 and 6.28).

Transversal musculature: The main musculature in chaetognaths is longitudinal. However, in *Eukrohnia* species, there is transversal musculature in the neck region (Figure 4.4).

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¹ N.B. In this paper, *Sagitta planctonis* and *S. zetesios* are switched.

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