

**The hydroid and medusa of *Sarsia bella* sp. nov.
(Hydrozoa, Anthoathecatae, Corynidae),
with a correction of the “life cycle” of
Polyorchis penicillatus (Eschscholtz)***

ANITA BRINCKMANN-VOSS

Centre for Biodiversity and Conservation Biology, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario, Canada, M5S 2C6. Mailing address: P.O.B. 653, Sooke, B.C. V0S 1N0, Canada. E-mail: anitab-voss@bc1.com

SUMMARY: A new hydrozoan, *Sarsia bella* sp. nov. is described in both its hydroid and medusa stage from north of Puget Sound, Washington in the San Juan Islands, USA and off the southernmost tip of Vancouver Island, Canada. The medusa is distinguished from other *Sarsia* species by 16 exumbrellar nematocyst patches and in being more transparent or “glass like” when living than any other known species of the genus. The exumbrellar nematocyst patches become indistinct in mature specimens and in those crowded in culture, with single nematocysts increasingly spaced out. The hydroid, both field-collected and raised in culture from its medusa, forms small, upright stolonal colonies not more than 1.5 mm high. The hydranths bear an oral whorl of four to five capitate tentacles, and immediately below a second whorl of slightly shorter capitate tentacles. In thriving colonies there is occasionally a whorl of small filiform tentacles on the lower part of the hydranth. Medusa buds develop in the middle of hydranth below the capitate tentacles and above the reduced filiform tentacles, if present. Young medusae are liberated with the typical 16 exumbrellar nematocyst patches. The hydroid of this species was originally mistaken for the hydroid of *Polyorchis penicillatus*. Brinckmann-Voss (1977) reported a small corynid hydroid living on the margin of rock scallop shells. Medusae liberated from this hydroid were at that time believed to be those of *Polyorchis penicillatus* (Eschscholtz) present in the plankton. Immature medusae of these two species appear strikingly similar, especially with regard to their exumbrellar nematocyst patches, four tentacles and abaxial ocelli. Since then however, this connection has been proven wrong, because an identical hydroid was raised from the medusae of the new species *Sarsia bella*. Second generation medusae raised in the laboratory were carefully compared with medusae liberated from field collected hydroids (thought to have been *Polyorchis penicillatus*), and these were found to be identical with medusae of *Sarsia bella*. Young medusae of *P. penicillatus* from the plankton can be clearly distinguished from *S. bella* medusae by the number of their exumbrellar nematocyst patches. Both *P. penicillatus* and *Sarsia bella* have eight adradial rows of exumbrellar nematocyst patches when young, however each row in *P. penicillatus* consists of at least three vertically aligned patches whereas each row never has more than two patches in *S. bella*. In both species the patches consist of microbasic p-mastigophores, but capsules in the case of *P. penicillatus* are larger than those in *S. bella*. Later stages of the two species are easily distinguished using other morphological characters with only four tentacles in *S. bella* and more than four in *P. penicillatus*. No hydroid of the genus *Polyorchis* has been described to date.

Key words: Leptolida; Anthoathecatae; Corynidae, *Sarsia*; Polyorchidae, *Polyorchis*.

INTRODUCTION

The taxonomy of the genus *Sarsia*, especially from the North East Pacific, has been problematic for a long

time (Arai and Brinckmann-Voss, 1980; Mills, 1982; Brinckmann-Voss, 1985). Only those species of *Sarsia* having medusae with a long manubrium, treated by Miller (1982) as belonging to the “tubulosa complex” will be considered here. The medusa stage of this species complex - common in the eastern section

*Received March 6, 1999. Accepted December 1, 1999.

of the Juan de Fuca Strait and the San Juan Islands (Fig. 1), occurs in different forms either considered "species," "subspecies" or "morphotypes" (Miller, 1982) in the same habitat. Miller's paper dealt with the medusa stage and first cleavage of their embryos only. Brinckmann-Voss (1985) followed the development of some of Miller's "types" to the hydroid and next medusa generations comparing them with additional field-collected hydroids. Some of Miller's results were confirmed, while certain morphotypes were definitely assigned to valid species. However, one of Miller's morphotypes, designated by him as the "L" type on account of the large eggs in the females, proved to be a separate, yet undescribed, species. Based on both young and adult specimens, or its hydroid raised from the medusa in the laboratory, and on observation of field-collected hydroid material, this species is described here as *Sarsia bella* sp. nov. The formerly mistaken connection (Brinckmann-Voss, 1977) of the hydroid of this new species with *Polyorchis penicillatus* will be discussed and corrected.

Sarsia viridis (see Brinckmann-Voss, 1980) will not be discussed in this paper. Although it is sympatric with *Sarsia bella* and the other species of the genus listed in Table 1, it can be easily distinguished from them morphologically by its small size and persistent green colour. In addition, *Sarsia viridis* is very rare and more information, especially about the hydroid, is needed.

MATERIAL AND METHODS

Sarsia bella medusae were collected regularly from floats in Friday Harbor, Washington, Becher Bay, and occasionally in the harbour of Sooke, British Columbia (Fig. 1). Females and males were placed in pairs in small custard cups to spawn. Filtered sea water was used, being at least three days old to avoid contamination with sperm from other *Sarsia* medusae in the field. As an additional control, female medusae alone and their eggs were observed. Embryos developed from the mating pairs were left in the same container for observation of settlement and development of the hydroids. Primary hydranths were raised to colonies as described in Brinckmann-Voss (1985). As the hydranths of this species have a tendency to regress if not aerated, leaving only the hydrorhiza, small stones with barnacles from the intertidal were added to the colonies. This stirring by natural feeding action of the barnacle cirri was preferable to simple aeration

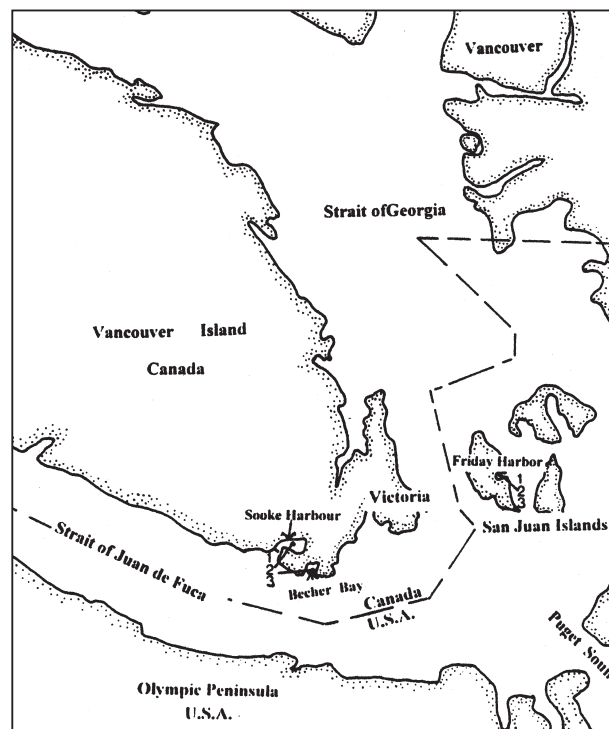


FIG. 1. – Main collection sites of the various *Sarsia* species being sympatric with *Sarsia bella* sp. nov.: 1: *Sarsia bella* sp. nov.; 2: *Sarsia apicula* (Murbach and Shearer, 1902); 3: *Sarsia princeps* (Haeckel, 1879).

with air stones because nauplii released from the barnacles acted also as perfect-sized prey for the small *Sarsia bella* hydranths. The hydroid cultures were kept at 5-10°C in an unheated room during the winter months, and outside or in a refrigerator during the summer (the research region of southern Vancouver Island region has cool summers with night temperatures rarely above 15°C.)

Field collected hydroids were collected from the outer and inner margin of rock scallop shells, *Hinnites multirugosus* (Gale) (syn. *Hinnites giganteus* Grey) from Departure Bay, British Columbia.

TAXONOMIC ACCOUNT

Sarsia bella sp. nov. (Figs. 2-6)

Type material: Holotype ROMIZ B3124, adult male medusa, 9 May, 1995, Becher Bay, off Vancouver Island, B.C. Canada, surface. Paratypes: ROMIZ B3125, male and female adult field collected medusae, 10 May, 1995; Becher Bay, off Vancouver Island, B.C. Canada; surface; with their hydroids and second generation medusae cultured. Paratype: RBCM 999-381-1; immature and mature medusae; 9 May, 1995; Becher Bay, off Vancouver Island, B.C., Canada; surface.

RBCM: Royal British Columbia Museum, Victoria, British Columbia, Canada

ROM: Royal Ontario Museum, Toronto, Ontario, Canada

Etymology: The new species was named *Sarsia bella* in reference to the delicate glass-like bell of the medusa.

Diagnosis: Medusae with 2 vertically aligned nematocyst patches in each of eight exumbrellar adradia; clearly visible in young specimens; individual cnidocysts more widely spaced and diminishing in numbers when medusae are crowded in culture or reaching maturity (compare Fig. 2 with Fig. 5). Gonads in distal half of manubrium only; female medusae with larger eggs than other *Sarsia* (Miller 1982, Table 1); Reddish (never blue) manubrium and marginal bulbs. Hydroids *Sarsia*- like, upright short stolonal colonies; hydranths emerging directly from hydrorhiza without distinct hydrocaulus; with feeble perisarc around base of hydranths; hydranths small, maximum length 1.5 mm (measured from hydrorhiza); with oral whorl of 4-5 tentacles, and

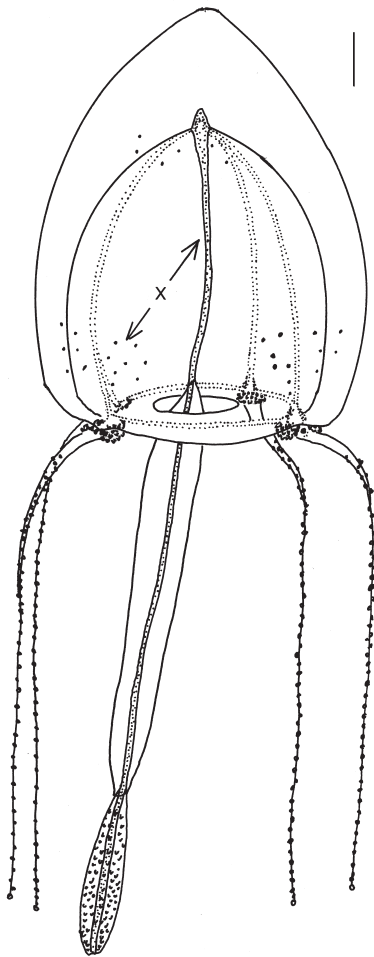


FIG. 2. – *Sarsia bella*; adult male medusa Becher Bay; 0 m; x: specific characters: gonad free part of manubrium and exumbrellar cnidocyst patches. Scale = 1.0 mm



FIG. 3. – *Sarsia bella*, hydroid with medusa bud raised from medusae in the laboratory; tentacles slightly contracted. Scale = 0.1 mm.

second whorl with shorter tentacles just beneath the oral one; with or without minute filiform tentacles.

Description of medusa (Fig. 2): Living adult medusa with rounded to conical bell reaching a maximum 9 mm high, and 7.5 mm wide; with exumbrella thicker apically than laterally; with short, conical apical canal; with exumbrellar cnidocyst patches faintly visible or absent; with individual cnidocysts more widely separated than in young specimens; manubrium nearly three times as long as exumbrella, with gonads encircling distal part of manubrium except stomach leaving about proximal half of manubrium gonad free. Four marginal bulbs with abaxial ocelli, but without abaxial spurs; tentacles with cnidocyst clusters scattered proximally, becoming more moniliform distally.

Hydroid raised from medusa (Fig. 3): stolonal short colonies not more than 1.5 mm high with hydranths rising directly from a creeping net-like hydrorhiza without clear separation of hydranths and hydrocaulus (terminology used after Millard

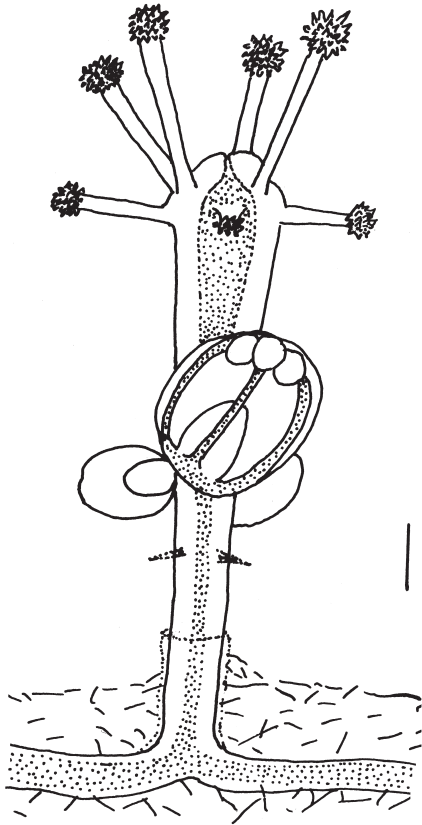


FIG. 4. – *Sarsia bella*, after sketch from living hydroid from field-collected rock scallop. Small filiform tentacles below medusa buds only occasionally present. Scale = 0.1mm

1975, Cornelius 1996); with an oral whorl of 4-5 short capitate tentacles, each not more than 0.4 mm long; with tentacles of second whorl half the length of the oral ones; maximum thickness of oral tentacle bulb $56\ \mu\text{m}$, $40\ \mu\text{m}$ in lower tentacles; usually only 10 endodermal cells in oral tentacles; up to five medusa buds in middle of hydranths; occasionally (Fig. 4) four small, reduced filiform tentacles in area below medusa buds, these present in thriving and relaxed colonies only; usually absent as in Figure 3.

Hydroids from field-collected material (Fig. 4) on the shell margin of rock scallops appear identical to hydroids raised from the medusae in the laboratory, except for the hydrorhiza and proximal part of hydranth being imbedded in an incrusting sponge which often covers part of the margins of rock scallops.

Medusae liberated from their hydroids are 1 mm high and 1 mm wide. Exumbrella with 16 patches of nematocysts - two per each of eight adradia (Fig. 5); each patch consisting of 6-11 densely packed microbasic p-mastigophores. During growth of the exumbrella, the nematocysts become more scattered

or widely separated and often disappear as the medusae mature; the upper patches tend to disappear before the lower ones. During development, the manubrium getting longer than the subumbrella and gonads develop. Initially when the manubrium has not reached its full length, gonads seem to be thicker distally than proximally, so that the manubrium appears spindle-shaped in juvenile specimens; but in mature medusae, the gonads are limited to the distal part of the manubrium, leaving its proximal part gonad-free. In alcohol-preserved specimens, mature medusae measure between 5.8/5.0 mm and 8.0/7.6 mm in height/diameter. Diameter of eggs is $129\ \mu\text{m}$ (see Miller 1982 for *Sarsia* "L"). In the present study the egg diameter is slightly less, 110-120 μm , but still considerably larger than those of the sympatric species *Sarsia apicula* (Murbach and Shearer 1902) (as *Sarsia* "S" in Miller, 1982; see Discussion).

The ciliated planula settles on the bottom of glass dishes and primary hydranths were observed 10 to



FIG. 5. – *Sarsia bella*, one day old medusa liberated from hydroid. The box at the left indicates nematocyst cluster shown enlarged in Figure 6a. Scale = 0.09mm.



FIG. 6. – *Sarsia bella*; a. enlargement of box insert from Figure 5; magnified: part of bell of young medusa with group of microbasic p mastigophores photographed at kink of exumbrella, unexploded ; b. hydroid: large isorhiza with 2 adjacent stenoteles. Scale a,b = 10 μ m.

14 days after spawning. In contrast to this new species, the planulae of *Sarsia apicula* develop into primary hydranths after only 48 hours.

Medusa buds develop between March and May in cultures kept at about 8–12°C. The field-collected hydroids off the British Columbia coast were found with medusa buds in the beginning of March at a sea-water temperature of 9°C.

Nematocysts (all measurements are in μ m): *Sarsia bella* medusae: stenoteles undischarged 9–13 \times 7–9; desmonemes undischarged 7–9 \times 4–5; microbasic p-mastigophores 11–12.5 \times 8–10; Hydroid: stenoteles undischarged 12–18 \times 7–12; homotrichous isorhizas 14–15 \times 5–7.

Remarks: although stenoteles in other species of *Sarsia* typically appear to be in two size groups

(Brinckmann-Voss, 1985, 1989; Calder, 1988; Kubota and Takashima, 1992; Schuchert, 1996) these two size ranges are less distinct in *Sarsia bella*.

Distribution: the medusa stage of *Sarsia bella* has been found occasionally in Sooke, frequently in Becher Bay and Friday Harbor (Fig. 1). The hydroid was collected in Departure Bay off Nanaimo, B.C. Although intensive collecting was done in Departure Bay, *Sarsia bella* medusae were not found there.

DISCUSSION

Generic distinctions within the Corynidae have been under discussion for a number of years. Petersen (1990), with the help of cladistic methods, improved earlier concepts by trying to arrange the family into three genera (*Sarsia*, *Coryne* and *Dipurena*) according to different characters of hydroid and medusae. Although *Sarsia bella* fits Petersen’s definition of the genus *Sarsia*, some of the characters used by him seem to be unreliable as a generic distinction: these include shape of marginal bulbs of the medusae and position of medusa buds on the hydroids (author’s personal observation; Kubota and Takashima 1992). Additional characters such as morphology of the tentacles in the hydroid, should also be considered to define the three genera.

Sarsia bella is one of the two common “sibling” species of the genus *Sarsia* which occur in certain bays off southern Vancouver Island and Friday Harbor. Miller (1982) considered these belonging to a *Sarsia tubulosa* complex, but recent hybridization experiments between Friday Harbor and Becher Bay specimens and subsequent raising of the primary hydranths of both forms (Brinckmann-Voss, work in progress) reveal that Miller’s Friday Harbor “S” type is actually *Sarsia apicula* (Murbach and Shearer, 1902) and not a morphotype of *Sarsia tubulosa* (M. Sars, 1835) as suggested in Figure 4 of his paper (Miller, 1982, p.161). The species *Sarsia tubulosa* (M. Sars, 1835) is present in Sooke Harbour, but much rarer or absent in Friday Harbor, where Miller did his work; Miller’s “L” type is, as he suggested, a separate species described above as the new species *Sarsia bella*. Although Miller reported up to 37.7% successful early cleavage stages in his hybridization experiments of *Sarsia bella* sp.nov. and *S. apicula* (Murbach and Shearer, 1902) (S and L morphotype in Miller, 1982), recent hybridization

TABLE 1. – Different *Sarsia* species sympatric with *Sarsia bella* spec. nov. in three locations off the south coast of Vancouver Island, B.C. Canada and San Juan Islands, Wash. USA.

Species	Distinctive Characters		Seasonal Distribution	Location
	Medusa	Hydroid		
<i>Sarsia bella</i> sp. nov. (<i>Sarsia</i> “L” in Miller, 1982)	16 exumbrellar dense cnidocyst patches in immature specimens, diminishing in adults; gonads in distal half of manubrium only; egg diameter more than 100 μ m; sympatric with <i>S. apicula</i> , but no hybridization *	small, less than 1.5 mm, no distinct hydrocaulus. 2 whorls of capitate tentacles; 2nd whorl smaller than 1st; endodermal cells in oral tentacles not more than 10	Medusa: early May to mid- June; Hydroid: with medusa buds in March	Medusa: Friday Harbor Labs floats abundant; Becher Bay abundant; Sooke, rare. Hydroid: on margin of live rock scallop shells.
<i>Sarsia apicula</i> (Murbach and Shearer, 1902) (<i>Sarsia</i> “S” in Miller, 1982)	scattered exumbrellar cnidocysts in immature specimens, none in adults; gonads entire length of manubrium, leaving only most proximal part free; egg diameter less than 100 μ m	large, 2 mm or longer; distinct hydrocaulus of various lengths; 3 whorls of capitate tentacles; more than 15 endodermal cells in oral tentacles	Medusa: early May to mid-July;	Medusa: Friday Harbor off floats; Becher Bay; Sooke; common in all three locations. Hydroid: intertidal
<i>Sarsia princeps</i> (Haeckel, 1879) (<i>Sarsia</i> “P” in Miller, 1982)	exumbrellar cnidocysts in 8 loose exumbrellar patches plus scattered exumbrellar cnidocysts in liberated medusa; none in adult; gonads entire length of manubrium, leaving only most proximal part free; egg diameter less than 100 μ m; more pointed exumbrella than any other <i>Sarsia</i>	hydroid slender, two capitate tentacle whorls; hydrocaulus clearly separated from hydranth	Medusa: May	Medusa: Friday Harbor off floats; Becher Bay; Sooke; not abundant in all three locations. Hydroid on live swimming scallop shells.
<i>Sarsia tubulosa</i> (M. Sars, 1835) and <i>Sarsia tubulosa</i> , small blue variety (<i>Sarsia</i> “B” in Miller, 1982)	this species and its varieties are either spatially or temporally separated from the new species <i>Sarsia bella</i> (Brinckmann-Voss 1985, and work in progress)			See Discussion

*In this paper hybridization means development from heterozygotic matings not just to first cleavage stages but to the primary hydranths, and subsequent formation of colonies.

experiments (Brinckmann-Voss, A. work in progress) between the two species - or heterotypic matings of the two morphotypes as phrased by Miller (1982, p. 163) - did not result in any primary hydranths. Instead embryos from homotypic matings developed into primary hydranths about 90% of the time (Brinckmann-Voss, A. work in progress). Furthermore, *Sarsia bella* can be morphologically distinguished from a small blue *Sarsia*, “B” type in Miller (1982), collected in Parks Bay, Shaw Island (San Juan Islands), and considered by him belonging to the same “tubulosa” morphotype. In addition to their morphological distinction in the medusa and hydroid stage, both species are spatially or temporally separated from each other. *Sarsia* “P” type (Miller, 1982), or *Sarsia princeps* (Haeckel, 1879), can be easily distinguished from *Sarsia bella* (Table

1) by the morphology of the medusa as well as the hydroid (Arai, and Brinckmann-Voss, 1980; Brinckmann-Voss, 1985).

The hydroid now identified as *Sarsia bella* which occurs on the rim of the shells of the rock scallop, *Hinnites giganteus*, was mistakenly reported as the hydroid of *Polyorchis penicillatus* Eschscholtz in an earlier paper (Brinckmann-Voss, 1977). The mistake happened because of the similarity between newly-liberated medusae from the hydroid living on rock scallops and the youngest stages of the medusa *P. penicillatus* collected separately from the plankton. Although both species look strikingly similar in their youngest medusa stage, they can be easily distinguished from each other: *Sarsia bella* never has more than two vertically alligned nematocyst patches on each of the 8 adradia as shown earlier (Fig. 5

present paper and Brinckmann-Voss, 1977, Fig. 2 mistakenly as *P. penicillatus*), whereas the youngest *P. penicillatus* - known from plankton only - has three or more (Mills, 1976, Fig. 2.7; Brinckmann-Voss, 1977, Fig. 3), and as described for the similar *Polyorchis karafutoensis* (Nagao, 1970). Nematocysts on the exumbrellar patches of the young medusae are microbasic p-mastigophores in both species, but they are nearly one-third larger in *P. penicillatus* than in *S. bella*. The hydroid of *P. penicillatus* is still not known, nor is any hydroid of its family, the Polyorchidae.

ACKNOWLEDGEMENTS

I thank Richard Miller and Claudia Mills for providing me with live medusa specimens from Friday Harbor. I also thank Dale Calder and Claudia Mills for critically reviewing and discussing this manuscript.

REFERENCES

- Arai, M.N. and A. Brinckmann-Voss. – 1980. Hydromedusae of British Columbia and Puget Sound. *Can. Bull. Fish. Aquat. Sci.*, 204: 1-192.
- Brinckmann-Voss, A. – 1977. The hydroid of *Polyorchis penicillatus* (Eschscholtz) (Polyorchidae, Hydrozoa, Cnidaria). *Can. J. Zool.*, 55 (1): 93-96.
- Brinckmann-Voss, A. – 1980. A new species of the genus *Sarsia* (Hydrozoa, Corynidae) from Vancouver Island and Puget Sound. *Royal Ont. Mus. Life Sci. Occas. Pap.* No. 34: 1-4.
- Brinckmann-Voss, A. – 1985. Hydroids and medusae of *Sarsia apicula* (Murbach and Shearer, 1902) and *Sarsia princeps* (Haeckel, 1879) from British Columbia and Puget Sound with an evaluation of their taxonomic characters. *Can. J. Zool.*, 63 (3): 673-681.
- Brinckmann-Voss, A. – 1989. *Sarsia cliffordi* n. sp. (Cnidaria, Hydrozoa, Anthomedusae) from British Columbia with distribution records and evaluation of related species. *Can. J. Zool.* 67: 685-691.
- Calder, D.R. – 1988. Shallow-water hydroids of Bermuda the Athecatae. *Royal Ontario Museum Life Sciences Contributions*, 148: 1-107
- Cornelius, P.F.S. – 1995. North West European Thecate Hydroids and their Medusae, Part 1. *Synopsis of the British Fauna (New Series)*, No. 50: 1-347. (Publ. Linnean Soc. London)
- Kubota, S. and Y. Takashima. – 1992. Redescription of *Sarsia japonica* (Nagao) (Hydrozoa, Corynidae) from Hokkaido, Japan. *Publ. Seto Mar. Biol. Laboratory*, 35(6): 371- 381.
- Millard, N.A.H. – 1975. Monograph on the Hydroida of Southern Africa. *Ann. S. Afr. Mus., Cape Town*, 68: 1- 513.
- Miller, R.L. – 1982. Identification of sibling species within the “*Sarsia tubulosa* complex” at Friday Harbor, Washington (Hydrozoa, Anthomedusae). *J. Exp. Mar. Biol. Ecol.*, 62: 153-172.
- Mills, C.E. – 1976. Studies on the behaviour and life histories of several species of hydroids and hydromedusae. M.S. thesis, Florida State University, Tallahassee, Florida, USA.
- Mills, C.E. – 1982. *Patterns and mechanisms of vertical distribution of medusae and ctenophores*. Ph.D. dissertation, University of Victoria, Victoria, B.C., Canada, 384 pp.
- Nagao, Z. – 1970. The metamorphosis of the anthomedusa, *Polyorchis karafutoensis* Kishinouye. *Publ. Seto Mar. Biol. Lab.*, 18: 21-35.
- Petersen, K.W. – 1990. Evolution and Taxonomy in Capitata Hydroids and Medusae. *Zool. J. Linnean Soc.*, 100: 101-231.
- Schuchert, P. – 1996. The Marine Fauna of New Zealand: Athecate Hydroids and their Medusae (Cnidaria, Hydrozoa). *New Zealand Oceanogr. Inst. Mem.*, 106: 1-159.