BioInvasions Records (2013) Volume 2, Issue 1: 33–38
doi: http://dx.doi.org/10.3391/bir.2013.2.1.05

Open Access

Short Communication

Sertularella mutsuensis Stechow, 1931 (Cnidaria: Hydrozoa: Sertulariidae) from Japanese tsunami debris: systematics and evidence for transoceanic dispersal

Henry H. C. Choong* and Dale R. Calder

Invertebrate Zoology Section, Department of Natural History, Royal Ontario Museum,100 Queen's Park, Toronto, Ontario, Canada, M5S 2C6

E-mail: henryc@rom.on.ca (HC), dalec@rom.on.ca (DC)

**Corresponding author*

Received: 21 September 2012 / Accepted: 3 December 2012 / Published online: 19 December 2012

Handling editor: Vadim Panov

Abstract

The leptothecate hydroid *Sertularella mutsuensis* Stechow, 1931 is reported on debris from the 2011 Japanese tsunami that came ashore on 5 June 2012 at Agate Beach north of Newport, Oregon. Its discovery on a barnacle (*Semibalanus cariosus*) from a derelict floating dock originating at Misawa, Honshu, confirms the capability of successful transoceanic dispersal for this species. We compare our specimens to Stechow's syntype material of *S. mutsuensis* in collections at the Zoologische Staatssammlung München, and designate a lectotype and paralectotype of the species.

Key words: Leptothecata; hydroid; lectotype; transoceanic dispersal; anthropogenic debris; Oregon coast

Introduction

The catastrophic Tôhoku earthquake and tsunami of 11 March 2011 resulted in floating debris extending thousands of kilometers to the north of Hawai'i in the Pacific Ocean, some of which has appeared on the west coast of the United States (NOAA 2012). A188-ton dock originating from Misawa, Honshu, Japan, came ashore on 5 June 2012 at Agate Beach, 4.7 kilometers north of Newport, Lincoln County, Oregon (ANS 2012). The derelict dock carried with it a substantial fouling assemblage, including over 100 non-native species (J. T. Carlton, Williams College – Mystic Seaport, Mystic, CT, pers. comm., November 2012).

We report the first transoceanic dispersal record of the western Pacific hydroid *Sertularella mutsuensis* Stechow, 1931, collected from the Misawa floating dock, and discuss the taxonomic and ecological implications of this occurrence. *Sertularella mutsuensis* was first described from Suzu-uti Mura, near Asamushi, Mutsu Bay, Japan, and has not been reported from North American waters.

Materials and methods

Colony fragments of the hydroid *Sertularella mutsuensis* reported herein were found attached to a barnacle *Semibalanus cariosus* (Pallas, 1788) collected from the Japanese dock that stranded on Agate Beach, Oregon, on June 5, 2012. Specimens were fixed in 95% EtOH, preserved in 75% solution, and deposited in collections of the Invertebrate Zoology Section, Department of Natural History, Royal Ontario Museum (ROMIZ B3955). They were compared with photomicrographs of type material of *S. mutsuensis* sent to us by Dr. Bernhard Ruthensteiner of the Zoologische Staatssammlung München (ZSM), Germany.

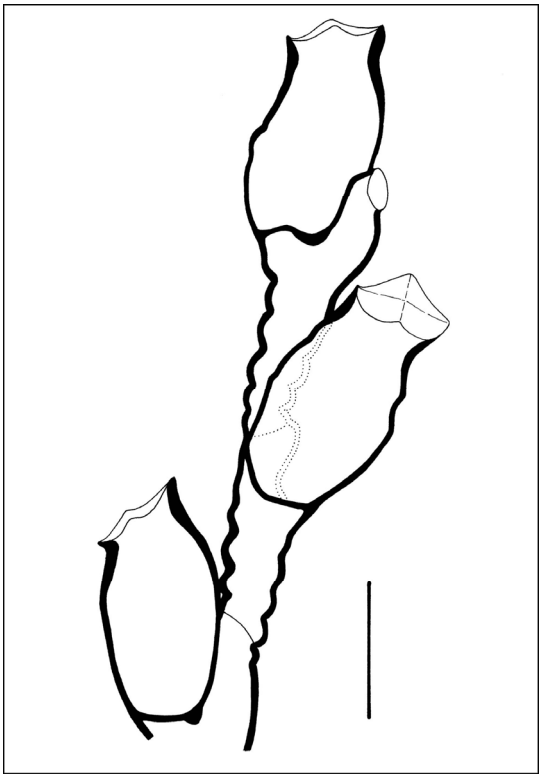

Figure 1. *Sertularella mutsuensis* Stechow, 1931 from derelict dock, Agate Beach, north of Newport, Lincoln County, Oregon, ROMIZ B3955. Fragment of a hydrocaulus, with three hydrothecae. Scale bar = 250 µm.

Description and diagnosis

Order Leptothecata Cornelius, 1992
Family Sertulariidae Lamouroux, 1812
Genus *Sertularella* Gray, 1848
Species *Sertularella mutsuensis* Stechow, 1931 (Figure 1)

Description of Misawa, Japan, dock specimens

Colonies both stolonal and on short, erect, non-ramified hydrocauli; hydrorhiza smooth, creeping, loosely reticulated. Stolonal form bearing a terminal hydrotheca supported on wrinkled pedicel of varied length having two to three spiral twists; hydrothecal pedicels *ca*. 190 µm long, roughly equal in diameter throughout or slightly increasing in diameter proximally. Erect form with rudimentary hydrocauli, comprising a vertical series of at least two hydrothecae (linear or opposite) supported by wrinkled hydrothecal internodes. Each except for proximal-most internode arising from base of hydrotheca immediately below. Internode adjacent to hydrotheca sometimes swollen. In series, up to half of distal hydrotheca may be fused to pedicel of proximal hydrotheca. Hydrotheca narrowing distally to a short, smooth neck 60 µm in length. Neck measured from point where hydrotheca narrows. Hydrothecae up to 560 µm in length; 240 µm maximum diameter, exhibiting bilateral symmetry due to slight bulge of hydrothecal wall on distal end proximal to hydrothecal aperture, causing neck to bend forward slightly; hydrothecal walls either smooth or with slight, incomplete annulations. Hydrothecal rim with four rather low, slightly rounded, equal-sized cusps; operculum of four equal, triangular valves converging centrally to form a pyramidal structure, peak elevated above hydrothecal margin. Intrathecal projections not present. Perisarc thickening prominent, up to 20 µm until base of neck; thickest from neck to opercular margin, up to 40 µm. Hydrothecal base also thickened, forming an almost-complete diaphragm. Hydranths contracted and poorly preserved; tentacle type, numbers, and structure not discernible in this material. Gonothecae not observed.

Diagnosis

The differential perisarcal thickening observed in *Sertularella mutsuensis* (Stechow 1931; Stechow and Uchida 1931) is present in our material. Except for the absence of intrathecal projections (cusps), this hydroid is morphologically indistinguishable from the original account of *S. mutsuensis* and we consider our material conspecific with it.

Discussion

Our specimens are morphologically distinct from species of *Sertularella* previously reported from the west coast of North America in systematic accounts of hydroids of the region including those of Clark (1876), Mereschkowsky (1878), Torrey (1902), Nutting (1899, 1901, 1904), and Fraser (1937) and from any previously observed by us. Instead, they correspond with descriptions of the northwestern North Pacific species *S. mutsuensis* in all but one reported character. Whereas three intrathecal projections were described in accounts of that species from Japan by Stechow, in Stechow and Uchida (1931), and Stechow (1931), such projections were absent in

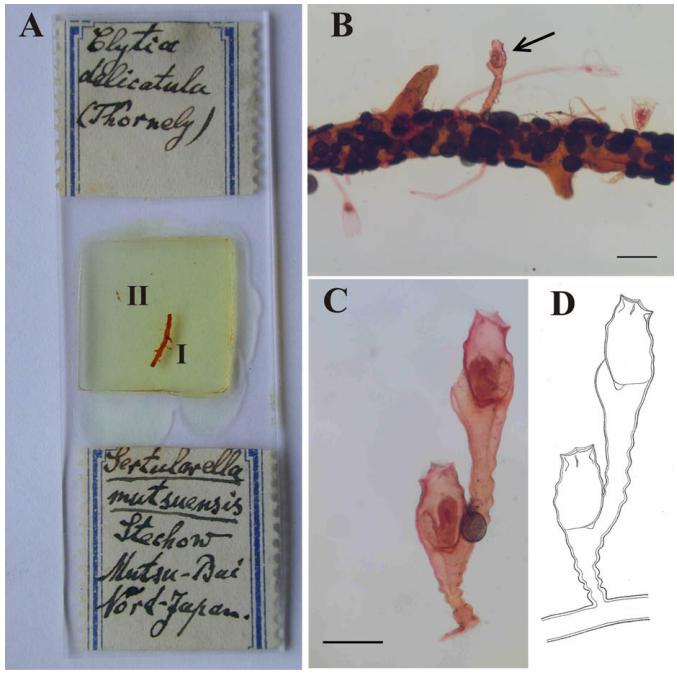

Figure 2. (A-C) *Sertularella mutsuensis*, Stechow's type material (ZSM 20041658): Microslide (A) showing both fragments, I and II, respectively designated herein as paralectotype and lectotype. Specimen I, the paralectotype (B), is a single pedicellate hydrotheca growing on an alga (indicated by arrow). Specimen II, the lectotype (C), is a non-ramified, erect hydrocaulus with a linear series of two hydrothecae. The lectotype matches the illustration (D) of *S. mutsuensis* type material in Stechow and Uchida 1931, p. 555, Figure 6. Scale bar = 500 µm (B) and 250 µm (B). Photography: A-C by Bernhard Ruthensteiner.

our specimens. Our analysis of photomicrographs of the type material shows that intrathecal projections are, in fact, absent from some polyps in that material.

Designation of paralectotype and lectotype

Hydroid colony fragments from Oregon were compared with photomicrographs of type material (microslide; ZSM 20041658) of *Sertularella mutsuensis*, deposited at the Zoologische Staatssammlung München (ZSM) (Figure 2A-C). Specimens on the type microslide, comprising two hydroid fragments, were considered to be syntypes by Ruthensteiner et al. (2008). One of the fragments (I) is a single pedicellate hydrotheca growing on an alga, possibly representing the basalmost of a series now broken off (Figure 2B). The other fragment (II), detached from any substrate, comprises a non-ramified hydrocaulus with a vertical series of two hydrothecae (Figure 2C). No gonothecae are present on either fragment. The slide bears a hand-written label with the following information: "*Sertularella mutsuensis, Stechow, Mutsu-Bai, Nord-Japan*" (commas added). A second label identifies a specimen of *Clytia delicatula* (Thornely, 1900) growing on the alga. No other identified specimens of *S. mutsuensis* are present in collections at the Zoologische Staatssammlung München (Ruthensteiner 2012, pers. comm.). A catalogue of Stechow's type material at the ZSM (Ruthensteiner et al. 2008) indicates the collection can be considered virtually intact, with the only missing type being one for a single species of *Campanularia*.

It is not known whether the two fragments on the type slide are from the same colony, and for nomenclatural purposes we therefore treat them as separate ones (i.e., as syntypes). Stechow did not designate a holotype of *S. mutsuensis*, but the section of hydrocaulus with two attached hydrothecae on the slide matches the illustration in Stechow and Uchida (1931, p. 555, Figure 6) (Figure 2D), and is certainly the same specimen. No illustration of the species was provided in a separate account of the species by Stechow (1931). Of the two fragments, the one illustrated in Stechow and Uchida (1931) is also the better specimen. Giving preference to an illustrated specimen when designating a lectotype, as per Recommendation 74B of the code (International Commission on Zoological Nomenclature 1999), we designate the colony fragment (II) on the slide corresponding with the illustration as the lectotype of *S. mutsuensis* Stechow, 1931 (Figure 2B). The other fragment on the microslide, (I), is designated as a paralectotype of the species (Figure 2A).

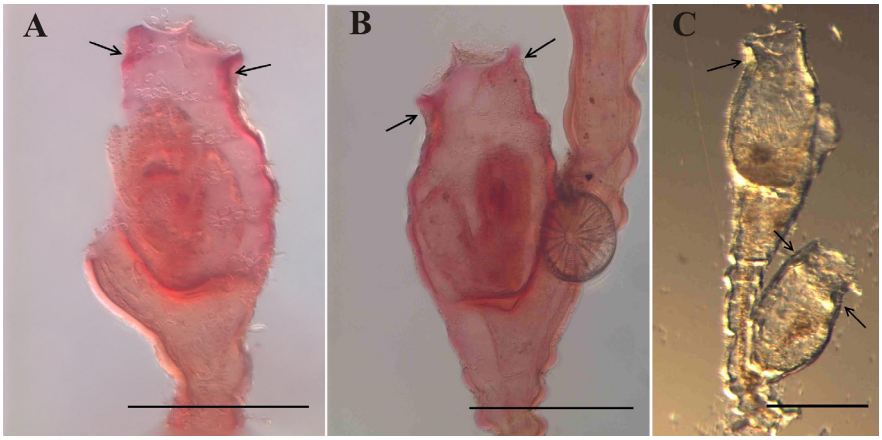

Figure 3. Detail of paralectotype (A), proximal hydrotheca of lectotype (B), and *Sertularella mutsuensis* from derelict dock, ROMIZ B3955 (C). Arrows indicate the thickening of the perisarc at the distal end of the hydrotheca which creates the appearance of intrathecal projections on adcauline and abcauline hydrothecal walls. Scale bars = 250µm. (Photomicrographs: A-B by Bernhard Ruthensteiner; C by Henry H.C. Choong).

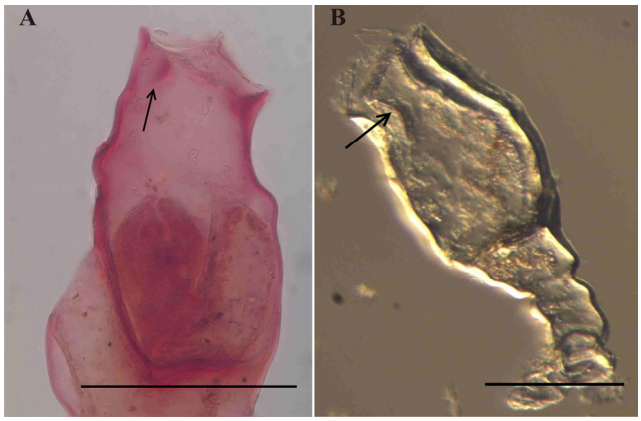

Figure 4. Detail of lectotype: distal hydrotheca (A), and pedicellate specimen of *Sertularella mutsuensis* from derelict dock (B). Arrows indicate the visual artifact caused by the thickened perisarc. Scale bars = 250 µm. (Photomicrographs: A by Bernhard Ruthensteiner; B by Henry H.C. Choong).

Taxonomic verification and implications

As for the absence of intrathecal projections in our material, the paralectotype of *S. mutsuensis* (Figure 3A) also appears to lack them and so does the proximal hydrotheca of the pair in the lectotype (Figure 3B). Moreover, the medial intrathecal projection shown in Stechow's illustration (Figure 2D) is not present on hydrothecae of the lectotype. However, photomicrographs of the lectotype and paralectotype, and of our material (Figure 3C) show that thickening of the perisarc at the distal end of the hydrotheca creates the appearance of intrathecal projections on adcauline and abcauline hydrothecal walls. Although the distal hydrotheca of the lectotype appears to have a projection in the near-medial position (Figure 4A), which could be the "medial intrathecal projection" that Stechow illustrated, we consider that to be an optical illusion, as photomicrographs of our material shows an identical "projection" (Figure 4B) that is not present on the actual specimen when examined under the microscope. It is apparent that the "medial intrathecal projection" in the photomicrograph is, in fact, a visual artifact caused by the thickened perisarc. Nevertheless, intrathecal projections may be absent or present in some species of *Sertularella*; for example, the number may vary from zero to five in *S. miurensis* Yamada, 1959 (Hirohito 1995). In an account of *S. mutsuensis* by Naumov (1969), intrathecal projections are neither mentioned nor illustrated. With all other characters being identical, we conclude that our specimens from the derelict dock are conspecific with *S. mutsuensis*.

Although Bouillon et al. (2006) and Millard (1975) regard colony form to be of generic value, and assign stolonal forms to a separate genus, *Calamphora* Allman, 1888, based primarily on the presence of a pedicel, the presence of stolonal and erect forms in the same colony in our sample, as well as within other species of *Sertularella* (e.g., *Sertularella maureenae* Choong et al. 2012), suggest that within Sertulariidae, colony form reflects conditions of growth rather than systematic relationships.

Confusion exists regarding the publication in which *Sertularella mutsuensis* was first described and when the specific name was made available nomenclaturally. It is clear that Stechow (1931) intended his account in *Zoologischer Anzeiger* to be the first description of the species because it is described therein under the heading "*Sertularella mutsuensis* n. sp." According to Vervoort (1995), that paper was published 15 October 1931. However, the species was described earlier from the same material, collected by Professor Hôzawa at the type locality at Mutsu Bay, northern Japan, as "*Sertularella mutsuensis* Stechow 1931" in a paper by Stechow and Uchida (1931) that appeared September of the same year (Vervoort 1995).The specific name is thus available from this earlier publication, although its authorship is restricted to Stechow, following Art. 50.1 of the code (International Commission on Zoological Nomenclature 1999), because he alone is credited as its author therein.

Ecological implications

The persistence of specimens of *S. mutsuensis* on the Misawa floating dock over 14 months at sea demonstrates that transoceanic movement of anthropogenic debris caused by tsunami or other natural disasters can potentially play a significant role in dispersal of hydroids. Rafting may be the most common means of dispersal of most clonal and aclonal species across greater distances (Jackson 1986; Calder 1993). The presence *S. mutsuensis* confirms that oceanic debris, in addition to phoretic substrates and shipping, can contribute to long-range dispersal of hydroids by rafting.

It is possible *S. mutsuensis* may have colonized the dock while it was still *in situ* in Misawa. However, as there were species observed on parts of the dock that were not submerged when the dock was anchored in Misawa (J. T. Carlton, Williams College - Mystic Seaport, Mystic, CT, pers. comm., November 2012), the extent to which the dock was colonized after it entered the open ocean remains unclear. Therefore, it is also possible that *S. mutsuensis* may have colonized the dock after it was torn away from Misawa. In addition to the type locality of Mutsu Bay, Japan, *S. mutsuensis* has been reported from the Sea of Japan and the Sea of Okhotsk, on the Pacific side of the southern Kuriles (Naumov 1969), and from Russky Island, Russia (Ivanova et al. 2008). The dock's drift trajectory may have taken it past the Sea of Okhotsk.

Nevertheless, *S. mutsuensis* is not indigenous to North American waters, and the presence of stolons, hydrocauli, and hydranths, though in poor condition when preserved, indicates that the hydroid survived its transoceanic passage. Moreover, dormant stages may enhance the dispersal of hydrozoan species by enabling them to survive otherwise limiting ecological conditions encountered during long-range transport (Calder 1993). Continued monitoring is important as anthropogenic rafts can greatly expedite the range expansion of marine organisms without an extended planktonic stage (Winston 2012).

Acknowledgements

We wish to thank the following persons: James T. Carlton of the Maritime Studies Program, Williams College–Mystic Seaport, for discovery of the hydroid reported here, for sending it to us for identification, and for reviewing the original manuscript; Horia R. Galea and Jan Watson also for reviewing the original manuscript; and all three reviewers for offering constructive comments on it; Vadim Panov for editorial help. Our gratitude is also extended to Bernhard Ruthensteiner, Section Leader of the Evertebrata varia Section, Zoologische Staatssammlung München, for photography of the type specimens of *Sertularella mutsuensis*, and for granting permission for some of the photographs to be reproduced here. Thanks are due as well to Claire J. Healy and Peter H. von Bitter for generous use of imaging equipment and laboratory facilities at The Royal Ontario Museum, and Maureen Zubowski for her collections management assistance. Specimens examined here were collected by John W. Chapman and Jessica A. Miller, with support of Oregon Sea Grant.

References

Allman GJ (1888) Report on the Hydroida dredged by H.M.S. Challenger during the years 1873-86. Part II.-The Tubularinae, Corymorphinae, Campanularinae, Sertularinae, and Thalamophora. Report on the scientific results of the voyage of H.M.S. Challenger during the years 1873–76, Zoology, 23, pp 1–90

ANS (2012) Aquatic Nuisance Species (ANS). http://anstaskforce.gov (Accessed 5 September 2012)

Bouillon J, Gravili C, Pagès F, Gili JM, Boero F (2006) An introduction to Hydrozoa. Mémoires du Múseum national d'Histoire naturelle, 194, 591 pp

Calder DR (1993) Local distribution and biogeography of the hydroids (Cnidaria) of Bermuda. *Caribbean Journal of Science* 29 (1–2): 61–74

Choong HHC, Calder DR, Brinckmann-Voss A (2012) *Sertularella maureenae*, a new species of hydroid (Cnidaria: Hydrozoa: Sertulariidae) from the Pacific coast of Canada. *Zootaxa* 3297: 57–63

Clark SF (1876) Report on the hydroids collected on the coast of Alaska and the Aleutian Islands, by W. H. Dall, U. S. Coast Survey, and party, from 1871 to 1874, inclusive. *Proceedings of the Academy of Natural Sciences of Philadelphia* 28: 209–238

Fraser CM (1937) Hydroids of the Pacific coast of Canada and the United States. University of Toronto Press, Toronto, 207 pp

Hirohito H.M. the Showa Emperor (1995) The hydroids of Sagami Bay. II, Thecata. Biological Laboratory, Imperial Household, Tokyo, 355 pp (English text), 244 pp (Japanese text)

International Commission on Zoological Nomenclature (1999) International Code of Zoological Nomenclature, 4th edn. London: International Trust for Zoological Nomenclature. http://www.nhm.ac.uk/hosted-sites/iczn/code/ (Accessed 12 September 2012)

Ivanova MB, Belogurova MS, Tsurpalo AP (2008) The composition and distribution of intertidal biota in the estuarine zone of Amursky Bay (Peter the Great Bay, Sea of Japan). In: Ecological studies and the state of the ecosystem of Amursky Bay and the estuarine zone of the Razdolnaya River (Sea of Japan), Volume 1, Vladivostok, Dalnauka, pp 92–142

Jackson JBC (1986) Modes of dispersal of clonal benthic invertebrates: consequences for species' distributions and genetic structure of local populations. *Bulletin of Marine Science* 39(2): 588–606

Mereschkowsky C (1878) New Hydroida from Ochotsk, Kamtschatka and other parts of the North Pacific Ocean. *Annals and Magazine of Natural History* 52: 433–451, http://dx.doi.org/10.1080/00222937808682454

Millard NAH (1975) Monograph on the Hydroida of southern Africa. *Annals of the South African Museum* 69: 1–513

Naumov DV (1969) Hydroids and Hydromedusae of the USSR. Fauna S.S.S.R. 70. Israel Program for Scientific Publications, 660 pp (English text)

NOAA (2012) National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program. http://www.marinedebris.noaa.gov/tsunamidebris (Accessed 5 September 2012)

Nutting CC (1899) Hydroida from Alaska and Puget Sound. *Proceedings of the United States National Museum* 21: 741–753, http://dx.doi.org/10.5479/si.00963801.21-1171.741

Nutting CC (1901) Papers from the Harriman Alaska Expedition. XXI. The hydroids. *Proceedings of the Washington Academy of Sciences* 3: 157–216

Nutting CC (1904) American hydroids. Part II. The Sertularidae. *Smithsonian Institution, United States National Museum Special Bulletin* 4(2): 1–325

Ruthensteiner B (2012) Zoologische Staatssammlung München. Personal communication. Cited 6 September 2012

Ruthensteiner B, Reinicke, GB, Straube N (2008) The type material of Hydrozoa described by Eberhard Stechow in the Zoologische Staatssammlung München. *Spixiana* 31: 3–27

Stechow E (1931) Neue Hydroiden von der MutsuBai, Nordjapan. *Zoologischer Anzeiger* 96(78): 177–187 (15.X.1931)

Stechow E, Uchida T (1931) Report of the Biological Survey of Mutsu Bay. 21. In: Hydroiden von MutsuBai, Nord-Japan. Science Reports of the Tôhoku Imperial University (Biology), Fourth Series, Volume 6(3), pp 545–571 (ix.1931)

Thornely LR (1900) The hydroid zoophytes collected by Dr. Willey in the southern seas. In Willey A, Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere, Part IV. Cambridge, Cambridge University Press, pp 451–457

Torrey HB (1902) The Hydroida of the Pacific coast of North America, with especial reference to the species in the collection of the University of California. University of California Publications, Zoology 1, pp 1–105

Winston JE (2012) Dispersal in marine organisms without a pelagic larval phase. *Integrative and Comparative Biology* 52: 447–457, http://dx.doi.org/10.1093/icb/ics040

Vervoort W (1995) Bibliography of Leptolida (non-Siphonophoran Hydrozoa, Cnidaria). Works published after 1910. *Zoologische Verhandelingen Leiden* 301: 1–432

Yamada M (1959) Hydroid fauna of Japanese and its adjacent waters. *Publications from the Akkeshi Marine Biological Station* 9: 1–101