

A Crustacean Endoparasite (Ascothoracida: Synagogidae) of an Antipatharian from Guam

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Abstract—*Sessilogoga elongata* n. gen. n. sp. is an endoparasite of an unidentified antipatharian from 9 m depth at Guam, living between the host's tissue and skeletal axis. The description is based on a female, males, and nauplius larvae. *Sessilogoga* is included in the Synagogidae and is very similar to the ectoparasitic genus *Synagoga* Norman, for which a revised diagnosis is given. The nauplii are similar to those of some Lauridae.

Introduction

The Ascothoracida are a small superorder of parasitic marine crustaceans that are related to barnacles and infest echinoderms and cnidarians. Grygier (1987c) provides a concise taxonomic review. Although there are fewer than 100 described species, they are interesting because they exhibit a wide range of morphological adaptations to parasitism and yet appear to be fairly primitive members of the crustacean class Maxillopoda.

The ascothoracidan order Laurida includes parasites of many different kinds of anthozoans, most often zoanthids, gorgonians, and scleractinian corals. Until now only one species has been reported as an associate of an antipatharian, or black coral, a group that has been extensively exploited commercially. [However, zoanthids overgrowing antipatharians can be infested (Grygier 1985c), and the zoanthid *Gerardia savaglia* (Bertolini), the host of the ascothoracidan *Laura gerardiae* de Lacaze-Duthiers, was originally thought to be an antipatharian (de Lacaze-Duthiers 1864).] *Synagoga mira* Norman, the type-species of its genus, was discovered attached externally to *Antipathes larix* Esper in the Bay of Naples in 1887 (Norman 1888, 1913), but has not been reported since. Of the three subsequently named and one unnamed species currently included in *Synagoga*, one was associated with an alcyonacean soft coral and the others were free in plankton tows or benthic samples (Grygier 1983, 1988, in press a). Personal observations of antipatharians housed at many major natural history museums have not turned up any additional ascothoracidans. It is therefore very exciting to be able to report a new species, closely related to but distinct from *Synagoga*, that is an endoparasite of an antipatharian at Guam. This is the species referred to as *Synagoga* sp. by Grygier (1987c: table 1), and it is also only the second ascothoracidan known from Micronesia. *Gorgonolaureus bikinien-sis* Utinomi (1962), redescribed by Grygier (1981), is an endoparasite of the gorgonian *Paracis squamata* (Nutting) from about 200 m at Bikini Atoll.

Family Synagogidae Gruvel, 1905
Genus *Sessilogoga* new genus

DIAGNOSIS—[Apomorphic or plesiomorphic character-state (A or P) judged with *Waginella* Grygier (1983) as outgroup.] Antennules much longer than oral cone (P); third segment with no long hairs (A); fourth segment with 2 short setae (P); fifth segment a little longer than sixth (P), setae of former much shorter than width of latter (A); claw guard bearing 3 setae (A), claw naked (P), claw-flanking setae short (A) and equal (P). Labrum lacking anterior patch of setae (P), maxillae with simple tips (P). Thoracopods decreasing substantially in length posteriorly (A), seminal receptacles in thoracopods II–V in females (P). No epaulets on sixth thoracomere (A). Biramous penis of males comparable in size to abdomen proper (A). Furcal rami at least 7.5 times longer than basal height (A); 3–4 short medial setae on each furcal ramus not contributing to tail fan (A); row of blunt spines (A) proximal to first ventral seta. Instar I nauplii pointed at rear, with spinose endites on antennae and mandibles and small furcal spines. Endoparasites of Antipatharia.

REMARKS—This diagnosis distinguishes *Sessilogoga* from *Synagoga*; further characters, distinguishing both genera from other members of the Synagogidae, are given in the Discussion. Using *Waginella* for outgroup comparison is not wholly satisfactory, since it has not been clearly demonstrated to be the plesiomorphic sister group of the remainder of the Synagogidae. However, it is equally plesiomorphic as *Synagoga* according to the character matrix in Grygier (1987c). The next closest outgroup, *Hansenocaris* Itô in the superorder Facetotecta (Grygier 1987a, Itô 1989), is of little use in this regard since its antennules and furcal rami are organized differently, and its mouthparts are vestigial.

ETYMOLOGY—from Latin *sessilis* (sitting), and part of the name of the related genus *Synagoga*; gender feminine.

TYPE-SPECIES—*Sessilogoga elongata* n. sp., by monotypy.

***Sessilogoga elongata* n. sp.**

DIAGNOSIS—As for genus (see above).

MATERIAL EXAMINED—Dissected male holotype (National Museum of Natural History, Smithsonian Institution, Cat. no. USNM 228258) and 4 paratypes and nauplii (USNM 228259). One male and 1 female paratype dissected and sexed on basis of gonads, penis morphology, and presence or absence of seminal receptacles; other paratypes left *in situ*, sex undetermined. Female not chosen as holotype because of poor condition of thoracopods. Drawings done with aid of camera lucida.

TYPE-LOCALITY—Guam, Stn. RFB 1059, 0.5 km N of Haputo Point, Tweed's Cave dive area, 9.1 m (13°34.9'N 144°49.8'E). Collected 23 Apr 1983 by R. F. Bolland. Species known only from type-locality.

HOST—Piece of main axis or branch of unidentified antipatharian 20 mm long, 2.6 mm thick, with tissue intact. Four parasite specimens (and many nauplii) found compressed between host tissue and skeletal axis, three of them in a group, and the fifth (holotype) loose in the bottle after sorting. Parasites detectable through host tissue as light colored, slightly raised ovals.

ETYMOLOGY—Named for elongate furcal rami.

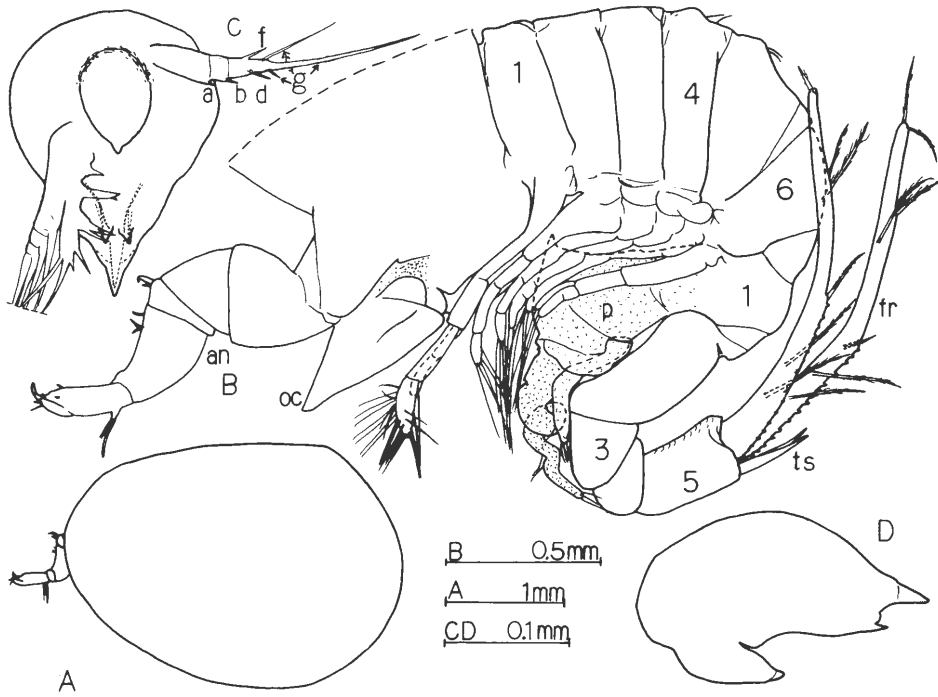


Figure 1. *Sessilogoga elongata* gen. n. sp. n. Paratype male (USNM 228259). A, carapace, lateral view with anteriorly protruding antennule; B, body removed from carapace, some thoracomeres and abdominal segments numbered, outline of penis dashed; C, nauplius, ventral view, left antennule and right mandible shown, setae of former labelled following Grygier (1987a); D, nauplius, lateral view, appendages omitted. Key: an, antennule; fr, furcal ramus; oc, oral cone; p, penis; ts, telsonic spine.

DESCRIPTION—Carapace: Bivalved, laterally compressed, valves oval but broader posteriorly (Fig. 1A). Female 3.9 mm long, height uncertain (valves not flat, but curved around host axis), two males 2.4 mm long, 1.8 mm high (holotype) and 2.8 mm long, 2.0 mm high; individuals left *in situ* approximately same size as these males. Thin, pliable outer cuticle not ornamented, but valve facing host axis bearing deep thorn imprints. Abundant long setae incidentally noted on inner cuticle of carapace in paratype male, no anterior pits observed. Gut diverticulum in each valve shaped like rounded W, with main anterior and posterior branches parallel to valve margins (not illustrated).

Body (Fig. 1B): Divided into head, thorax, and abdomen, wholly enclosed by carapace, lateral parts of head attached to carapace by powerful adductor muscles. Head with pair of large, forward-reaching antennules about twice as long as anteroventrally directed oral cone; small pair of frontal filament complexes. Thorax 6-segmented, first segment demarcated from head dorsally in female, dorsally and laterally in males. Fifth and sixth segments longer dorsally than others due to downturn of body, with few short, dorsal setae on segments 4–6. No lateral epaulets on sixth segment, but other segments with slight swellings at bases of legs. Six pairs of biramous thoracopods, progressively shorter

from front to rear, no filamentary appendages at base of first pair. Abdomen 5-segmented, U-shaped, second segment longest, then first and fifth segments, fourth segment shortest. First segment with very large, biramous, ventral penis in males, much smaller, uniramous one in female. Fifth segment (telson) with pair of large, posteroventral spines and pair of furcal rami 2–4 times as long as telson.

Antennules (Fig. 2A): Six-segmented, tapering distally; third segment triangular, fourth very short, sixth segment (excluding claw) shorter than fifth. Considerable freedom of movement between first 2 segments and between last 2, ventral (posterior) sides of middle 4 segments telescoped and dorsal (anterior) sides linked by hinge articulations. First 3 segments unarmed except for few proximal hairs on second. Fourth segment with 2 setae on upper (anterior) edge, distal one shorter. Fifth segment with 4–5 short setae proximally along upper (anterior) edge. Sixth segment with movable terminal claw with 3 small setae at base, medial and lateral setae of equal length; claw guard with 3 short, distal setae, 1 in front of apical hood [term introduced by Itô & Grygier (in press) for small distal flange on claw guard]; proximal sensory process well separated from claw guard and bearing 3 short, unequal setae and longer, more proximally arising aesthetasc. Musculature of generalized ascothoracidan type (cf. Grygier 1987b).

Frontal filament complexes: In holotype male, each a short, plumose branch with basal appendix (latter with apical lump in at least one of pair), clavate process, and extrinsic muscle inserting just distal to basal appendix (Fig. 2B). Whole structure equivalent to ventral ramus of similar organ in other synagogids, clavate process perhaps representing rudiment of posterior ramus or of basal aesthetasc of ventral ramus. In female, frontal filament complex consisting only of 3 aesthetascs and knob, latter with distal protrusion and ring of thickened chitin (for muscle attachment?) (Fig. 2C).

Oral cone: Triangular in side view, laterally compressed (Fig. 1B), 1.7 times longer than deep. Front side of labrum lacking setae, inner surface with dense, fine hairs intermeshing with those of mouthparts. Mouthparts typical for *Synagoga* (cf. Norman 1913, Grygier 1983) with following notable features: medial languette with series of inclined ridges along anterior margin, short fine hairs near point, and large subapical spine (Fig. 2D); mandibles with long, anteromedial tooth row, lanceolate tips variable in shape and in length of ventrolateral tooth row (Fig. 2E, F); proximal anteromedial edge of maxillules with several curved, widely spaced spines with extremely dense, fine hairs between, single comb of setae for rest of length (Fig. 2G), setae becoming much finer at tip; maxillae distally simple, lacking posterior hooks (Fig. 2H).

Thoracopods (Fig. 3): Anteroventrally flattened paddles consisting of long, slightly tapered coxa; shorter, rectangular basis; 2-segmented exopod longer than 3-segmented endopod (latter 2-segmented in thoracopods I and VI). Entire endopod only as long as first exopodal segment in thoracopod I; in other thoracopods rami much more similar in length, but endopods still shorter. Anomalies observed in male paratype: left thoracopod II with shrivelled, unsegmented endopod (Fig. 3C); exopod of left thoracopod IV with proximal lobe on second segment (Fig. 3E); endopod on both thoracopods V 2-segmented (Fig. 3G) [the same specimen has what seem to be excessively long furcal rami (cf. Figs. 1B and 2I) and may be considered abnormal]. Edges of thoracopods fringed with fine hairs, but posterior ones less hirsute. Terminal setae about half as long as thoracopods but relatively shorter in thoracopod I, most setae plumose; on thoracopod I, exopod with spinulose setae

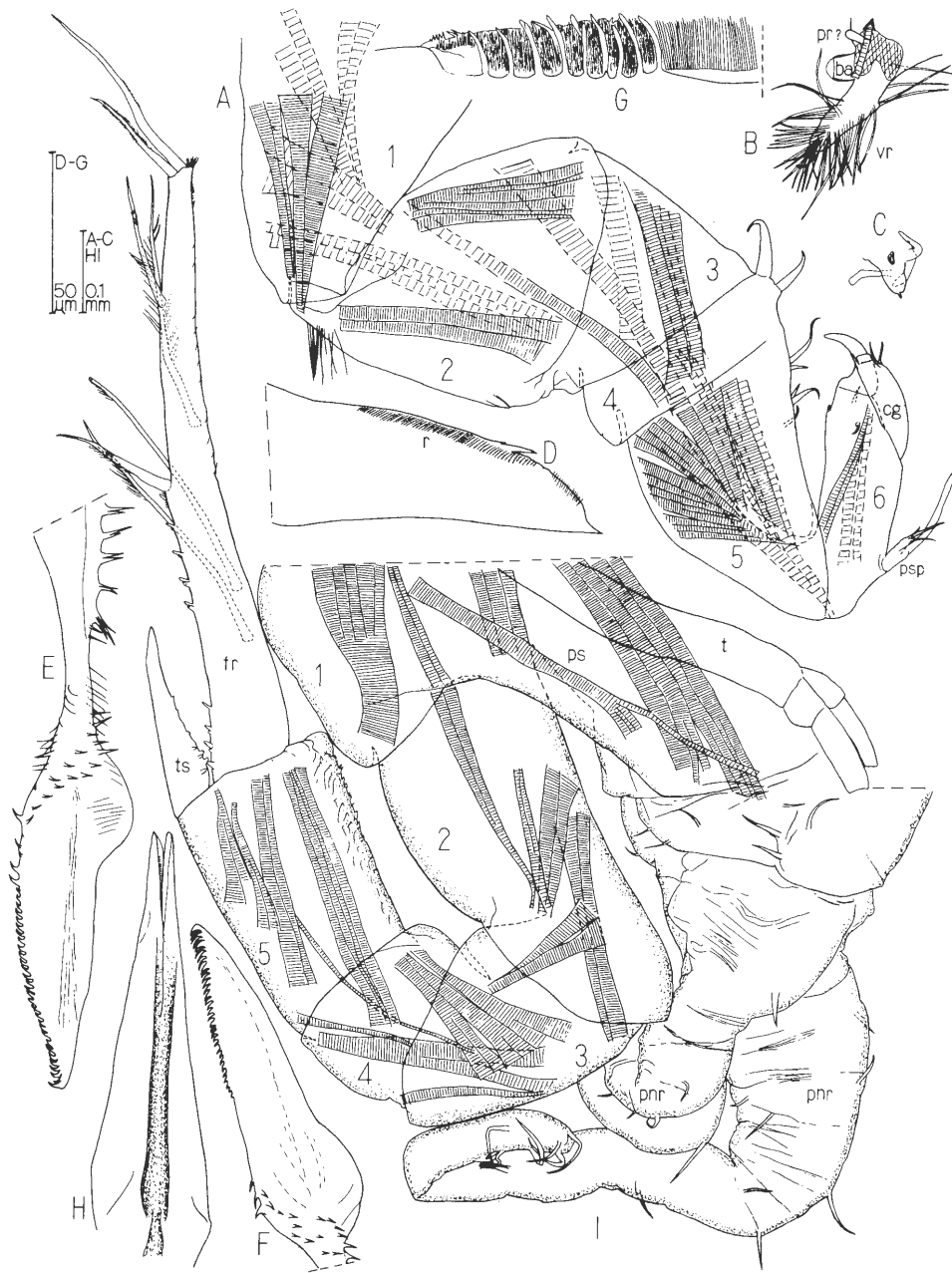


Figure 2. *Sessilogoga elongata* gen. n. sp. n., dissected parts. A, B, F, H, I, holotype male (USNM 228258); C, D, E, G, paratype female (USNM 228259). A, right antennule, lateral view, segments numbered, musculature shown (dashed muscles medial), drawn with proximal sensory process (psp) of left antennule; B, C, frontal filament complexes of male and female, respectively; D, medial languette; E, F, tips of mandibles of female and male, respectively; G, base of maxillule, distal direction towards right; H, maxillules, anterior view; I, abdomen, including right-side musculature, right furcal ramus, and part of penis. Key: ba, basal appendix; cg, claw guard; fr, furcal ramus; pnr, penis rami; pr?, posterior ramus?; ps, penis shaft; psp, posterior sensory process; t, thoracopod VI; ts, telsonic spine; vr, ventral ramus.



Figure 3. *Sessilogoga elongata* gen. n. sp. n., thoracopods. A, C–E, G–H, paratype male (USNM 228259); B, F, holotype male (USNM 228258). A, thoracopod I; B, basis and rami of thoracopod II; C, aberrant thoracopod II with short, unsegmented endopod; D, thoracopod IV, showing numbered sites for setal counts in Table 1; E, aberrant exopod of thoracopod IV with lobe (arrow); F, thoracopod V; G, aberrant thoracopod V with 2-segmented endopod; H, thoracopod VI. Key: n, endopod; x, exopod.

Table 1. Thoracopodal setation of *Sessilogoga elongata* n. gen. n. sp., complete data given for holotype (HR, right; HL, left) except for left thoracopod III, illustrative data given for male and female paratypes when markedly different from holotype (PMR, PML, male right and left, respectively; PFL, female left). Positions 1–9 marked on Fig. 3D. Parentheses for first segment of 2-segmented endopods, ranges and question marks indicating uncertainty. Asterisk (*) used when setal series of first exopod segment considered to include a few far distal setae on basis or intervening arthrodistal membrane.

Thoracopod/ Position	1	2	3	4	5	6	7	8	9
I HR	—	—	—	13	3	(2)		1	—
I HL	—	—	—	16	3	(2)		1	—
I PML	—	—	—	25–26	3	(2)		—	—
II HR	1	—	29?	7–8	3–4	3	2	6	—
II HL	1	—	30*	9	2	3	2	6	—
II PMR	1	—	33?	8	2	3	3–4	0–1	—
III HL	1	—	21*	8	2	2	2	5	—
III PFL	1	—	6?	12?	2	4?	4?	11?	—
IV HR	1	—	8	7	2	2	4	4	—
IV HL	1	—	6	7	2	2	3	3	—
IV PMR	1	—	6	7	2	1	1	2	—
IV PFL	1	—	>5	10–11?	2	3?	5	10	—
V HR	—	—	1	7	2	—	1	—	—
V HL	—	—	1	6	2	—	1	—	—
V PFL	—	—	1	8	2	1	1	4	—
VI HR	—	—	?	?	?	(1)		—	—
VI HL	—	—	?	?	?	(1)		—	—
VI PMR	—	—	—	4	2	(—)		—	—
VI PFL	—	—	—	6	2	(1)		—	—

in male paratype (Fig. 3A), but more plumose in holotype. In males, total unilateral thoracopodal setal count 155–170; detailed counts given in Table 1. Lateral coxal seta only on thoracopods II–IV (Fig. 3B, D), no medial coxal setae. First exopod segment of thoracopods II and III exhibiting setal multiplication (several groups of usually 4 thin setae; Fig. 3B, C). Little difference between setation of left and right thoracopods in holotype, but paratypes differing from holotype: male paratype with exopods of thoracopods I nearly twice as setose, and with different counts medially on thoracopods II and IV; female paratype with higher counts medially and on second exopod segment in thoracopod IV, medially on basis in thoracopods III and V. Female with 4–7 seminal receptacles each in coxae of thoracopods II–V. Thoracopodal musculature, although not examined in detail, similar to basic ascothoracidan type (cf. Grygier 1987b).

Penis: In female a digitiform, curved lobe about as long as posterior limb coxae (not illustrated). In males a very large, biramous structure approximately as large as entire rest of abdomen (Fig. 1B, 2I). Thick basal shaft extending forward between thoracopods, with

dorsally pointing spine at end; extrinsic muscles entering shaft from first abdominal segment. Intrinsic muscles originating along shaft's dorsal ridge line to insert within setose transitional region proximal to vermiform, sparsely setose pair of terminal rami (Fig. 2I).

Abdomen (Fig. 2I): Musculature of generalized ascothoracidan type except for near lack of lateral muscles, similar to that of *Cardomanica longispinatus* (Grygier) (cf. Grygier, 1984a: fig. 1E). Telson with denticulate scales dorsally. Posteroventral telsonic spines with small spinules, arranged on medial side into more or less regular rows. Furcal rami extremely long and thin, reaching to thoracomere 5 or 6 when abdomen folded; slightly upturned, with 2 unequal distal setae, 2 ventral setae at midlength and three-quarters length, and 3–4 medial setae; all setae with short setules. Ventral edge of rami in males with complete or incomplete row of up to 14 spines out to first ventral seta, spines fewer (7) and only found proximally in female.

NAUPLIUS LARVAE (Fig. 1C, D)—Instar I nauplii found between carapace valves of female (no special brood chamber) and some between valves of paratype male, but mostly between both specimens and host axis and free beneath host tissue for some distance around. Nauplii preparing to molt, so some details difficult to make out due to loose, thin cuticle.

Body about 0.23 mm long, 0.17 mm wide, 0.11 mm thick not including labrum, rounded in front, pointed at rear with pair of small, pointed furcal lobes. No nauplius eye, frontal filaments, or equatorial pores in instar I, but equatorial pores, thick terminal spine, and long pair each of furcal and maxillular setae present on developing instar II nauplius within. Naupliar limbs extending well beyond edges of body. Antennules (Fig. 1C) weakly segmented with 2 short medial setae (*a*, *b*), gap, short medial (*d*) and lateral (*f*) seta, and 3 unequal terminal setae (*g*) (letter designations as in Grygier, 1987a). No short *e* seta seen accompanying *d* seta. Antennae (not illustrated) with bifid enditic spines on coxa and basis and basal part of endopod, short seta at midlength of endopod, and 2 long and 1 short terminal endopodal setae, exopod annulate with 5 setae. Mandibles (Fig. 1C) like antennae except coxal endite with simple spine, possibly 2 setae at midlength of endopod, and 4 setae on exopod.

DISCUSSION—*Sessilogoga* is most similar to *Synagoga* and its separate generic status must be justified. The most recently published diagnosis of *Synagoga* (in Grygier 1983) was based on *S. mira* and *S. normani* Grygier and was designed principally to discriminate it from *Waginella*. Since then, an apparently juvenile specimen of *Synagoga* has been described from plankton in the Indian Ocean (Grygier 1988) and the descriptions of two new, deep-water, Atlantic species will be published soon (Grygier, in press a). The generic diagnosis of *Synagoga* should be reassessed in light of these additional forms and the present new species.

The supposedly diagnostic features of *Synagoga* that *Sessilogoga elongata* also shares include: no ventral or ventrolateral flattening of the carapace valves; a triangular third segment on the antennule, the claw guard well separated from the proximal sensory process, and the latter with 3 setae and an aesthetasc; a prominent medial languette in the oral cone and the same kind of complex armament of all the mouthparts except the maxillae; no filamentary appendages at the bases of thoracopods I and no laterodistal coxal seta on thoracopods I and V; tapered furcal rami with 2 ventral and 2 terminal setae (but 1 ventral and 3 terminal in one of the new species). If *Waginella* is taken as the outgroup, all

these features are synapomorphies of *Synagoga* and *Sessilogoga*, but I think the unflattened carapace valves, at least, are plesiomorphic.

Sessilogoga elongata differs with respect to some other purportedly diagnostic features of *Synagoga*, but so do some of the recently described forms of the latter genus. These features, which must now be qualified or abandoned, are: 2 spine-like setae on the fourth antennular segment; antennular claw denticulate or lined with short hairs; labrum with anterior patch of setae; thoracopods II–V with 3-segmented endopods; relatively large number of medial furcal setae.

Apomorphic and plesiomorphic features unique to *S. elongata* include body proportions and some aspects of the appendage armament as detailed in the generic diagnosis. Two other features deserve special note. In *Synagoga*, seminal receptacles have only been reported in *S. normani*, which has 1–2 each in thoracopods II–IV only, a more restricted distribution than the present species. Setal multiplication on the lateral edge of the proximal exopodal segment of thoracopods II–IV occurs both in the present species and in one of the new species of *Synagoga*.

Sessilogoga elongata is an endoparasite while *Synagoga* includes ectoparasites and evidently free-swimming forms. Some of the morphological differences, particularly body proportions and setal reductions, may be attributed to this life style. No particular reduction in thoracopodal setation is seen in *Sessilogoga*, but none is expected in light of the rather complex setation of synagogid ascothoracidans endoparasitic in gorgonians (e.g., Grygier 1984a, in press a).

No larvae of *Synagoga* have yet been described. Among the other ascothoracidans, instar I nauplii of *Sessilogoga elongata* are most similar in form and armament to those of many Lauridae, parasites of zoanthids (e.g., de Lacaze-Duthiers 1883, Grygier 1985, in press b). However, the present nauplii are smaller and have somewhat shorter antennal and mandibular enditic spines and relatively shorter furcal spines, and they appear to lack a few small setae present in generalized instar I laurid nauplii. It is not clear that later instars will be planktotrophic.

In summary, there seems to be adequate morphological justification for recognizing a new genus for the present species while not simultaneously leaving *Synagoga* paraphyletic. Besides the features listed above that distinguish both *Synagoga* and *Sessilogoga* from *Waginella*, the following constitutes an up-to-date diagnosis of *Synagoga* complementary to that of *Sessilogoga*. Plesiomorphies and apomorphies are marked as before, referring to *Waginella* as the outgroup.

***Synagoga* Norman, 1888**

Antennules comparable in size to oral cone (A); third segment with bed of long hairs (P); fourth segment with 2 large, thick setae or spinulate spines (A); fifth and sixth segments same length or sixth longer (A), setae of former longer than width of latter (P); claw usually with denticles or fringe of short hairs (A), lateral claw-flanking seta longer than medial one (A), claw guard, with one possible exception, bearing 4 setae (P). Maxillae with tiny, bifid, harpoon-like tips (A). Thoracopods subequal in length (P). Epaulets present on sixth thoracomere (P), but usually inconspicuous (A). Biramous penis of males small compared to abdomen proper (P). Furcal rami 4–5.5 times longer than basal height

(A, but less so than *Sessilogoga*); either 2 terminal and 2 ventral setae or 3 terminal and 1 ventral (A); variable number of long, medial setae contributing to tail fan (P); row of pointed spines (P) proximal to first ventral seta. Larvae unknown. Those with known hosts ectoparasites of Antipatharia and Alcyonacea; apparently free-swimming.

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