

Sargassum denticarpum Ajisaka sp. nov. and *S. longifructum* Tseng et Lu; two zygozarpic species of *Sargassum* (Phaeophyta) from Vietnam

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Two species of the section *Zygozarpicae*, subgenus *Sargassum* (Phaeophyta, Fucales, genus *Sargassum*) are reported for the first time from Vietnam. *Sargassum denticarpum* Ajisaka sp. nov. has pseudozygozarpic, androgynous receptacles, which are compressed and dentate at the margin. This species is endemic to Vietnam. *Sargassum longifructum* Tseng et Lu has holozygozarpic, dioecious receptacles. Its female receptacle is compressed with a dentate margin. The male receptacle is terete or slightly compressed, with an entire margin or a few spines. Female receptacles are described for the first time.

Key Index Words: Fucales—Phaeophyta—Sargassaceae—*Sargassum denticarpum*—*Sargassum longifructum*—Taxonomy—Vietnam—Zygozarpicae.

Pham-Hoang (1967, 1969) reported 39 species of the genus *Sargassum* from Vietnam, of which 31 belonged to the subgenus *Sargassum*. However, the identification of some species is doubtful, e.g. Tseng and Lu (1988) considered that *S. carpophyllum* sensu Pham-Hoang was in fact *S. parvivesiculosum* Tseng et Lu.

Recently, Nguyen (1986a, b) reported 22 *Sargassum* species from Vietnam, of which 19 species belonged to the subgenus *Sargassum*. However, he reported only 10 species, which have already been identified by Pham-Hoang (1967, 1969).

As a part of a critical re-survey of the marine flora of the Vietnamese coasts, we collected many specimens during a scientific survey of central to southern Vietnam in Jan.—Feb. 1993. Amongst the many species of the genus *Sargassum* which were collected, some belonged to the subgenus *Bactrophyucus*, and others to the subgenus *Sargassum*.

In this paper, we record the presence of two species in the section *Zygozarpicae* of the subgenus *Sargassum*, *Sargassum denticarpum* Ajisaka sp. nov. and *S. longifructum* Tseng et Lu, for the first time from Vietnam. The latter species was described from Naozhou Island, southern China (Tseng and Lu, 1987, 1988).

Materials and Methods

Plants of a new species, *S. denticarpum* were collected by snorkeling from St. 3 (Son Hai, Ninh Phuoc, Ninh Thuan Province: Jan. 21, 1993) and *S. longifructum* from St. 16 (Mui Nai, Ha Tien, Kien Giang Province: Feb. 5, 1993) in central to southern Vietnam (Fig. 1). *Sargassum denticarpum* grew on rocks at a depth of 1–5 m in clear water at the reef edge of a wide lagoon. *S. longifructum* grew on rocks or dead corals at a depth of 1 m along the fringing reef. The water was less clear at Station 16 due to suspended sediments and *S. longifructum* was restricted to shallow waters.

In addition, herbarium specimens collected in 1992 from central Vietnam were examined. The holotype specimen of *S. longifruc-*

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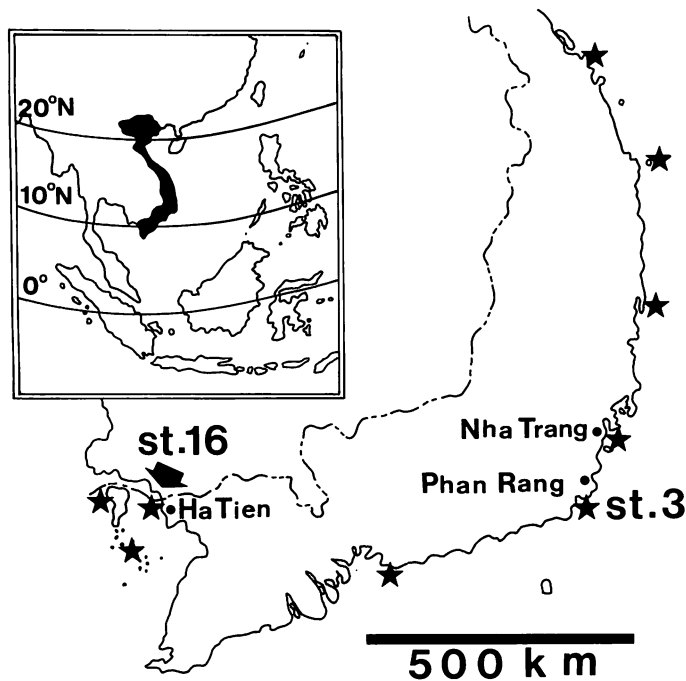


Fig. 1. Collection sites (solid stars) in the scientific survey of southern Vietnam from January to February, 1993. The type locality of *Sargassum denticarpum* is St. 3.

tum (AST 551767), deposited in the Herbarium of Institute of Oceanology, Academia Sinica, Qingdao was also examined. Abbreviations for herbaria follow Holmgren *et al.* (1990).

Observations and Discussion

Sargassum denticarpum Ajisaka sp. nov. (Figs. 2-10)

Hapteron discoideum vel conicum, usque ad 14 mm in diametro. Caulis erectus, teres, usque ad 10 mm in altitudine, usque ad 5 mm in diametro, pagina laevi, usque ad 5 ramos principales e parte distali ferens. Rami principales usque ad 50 cm longi, compressi prope partem proximalem, usque ad 5 mm lati, parum compressi vel angulares ad partem distalem, usque ad 3 mm lati, pagina laevi. Rami secundarii distiche 5 cm intervallo exorientes, usque ad 50 cm longi, pagina laevi. Folia breviter petiolata, simplicia, elongato-elliptica vel liniari-lanceolata, usque ad 5 cm longa, ad 2 cm lata, basi asymmetricis et apice acuto; margines irregulariter dentati; cryptostomata

conspicue effecta sed irregulariter in pagina omnino dispersa; costa conspicua, evanescens vel percurrens, interdum spinosa (Figs. 3 & 5). Vesiculae sphaericae vel ellipsoideae, usque ad 8.5 mm longae, ad 7 mm latae, apiculatae, cum vel sine appendiculis spinosis aut integeris ad apicem vel ad marginem, cryptostomatibus dispersis (Figs. 3 & 5-7, 9 & 10); petiolus brevis, teres vel foliaceus, usque ad 3 mm longus (Fig. 5).

Planta monoecia. Receptacula androgyna (conceptacula mascula pauca inter conceptacula femina, Fig. 4), compressa vel triquetra, usque ad 4 mm longa et 1 mm lata, simplicia furcata vel bifurcata, margine acute dentato, pseudozygocarpica.

Specimina viridi-brunnea ubi exsiccata.

Holdfast discoidal or conical, up to 14 mm in diameter. Stem erect, terete, up to 10 mm in height, up to 5 mm in diameter, with a smooth surface, bearing up to five primary branches from the distal portion. Primary branches up to 50 cm long, compressed near the proximal portion, up to 5 mm wide,



Fig. 2. Plant of *Sargassum denticarpum* (Holotype KYA930201) Scale: 10 cm.

Fig. 3. Apical portion of secondary branches of *S. denticarpum*, collected at Nha Trang, 21 Mar. 1992.

Fig. 4. Transverse section of an androgynous receptacle of *S. denticarpum*, showing antheridial and oogonial conceptacles on the same section. Plant collected at Nha Trang, 21 Mar. 1992. Scale: 100 μ m.

slightly compressed or angular at the distal portion, up to 3 mm wide, with a smooth surface. Secondary branches arising distichously at 5 cm intervals, up to 50 cm long, with a smooth surface. Leaves shortly petiolate, simple, elongate-elliptical or linear-lanceolate, up to 5 cm long, up to 2 cm wide, with an asymmetrical base and an acute apex; margins irregularly dentate; cryptostomata conspicuously developed but irregularly scattered throughout the surface; midrib conspicuous, evanescent or percurrent, sometimes spinose (Figs. 3 & 5). Vesicles spherical to ellipsoid, up to 8.5 mm long, up to 7 mm wide, apiculate, with or without spinose or entire appendages at the apex or margin, with scattered cryptostomata (Figs. 3, 5-7, 9 & 10): stalk short, terete or foliaceous, up to 3 mm long (Fig. 5).

Plant monoecious. Receptacles androgynous (few male conceptacles amongst the female conceptacles; Fig. 4), compressed or triquetrous, up to 4 mm long, up to 1 mm wide, simple, furcate or bifurcate, with acutely dentate margin, pseudozygocarpic (Figs. 3, 5-10).

Specimens greenish-brown when dried.

Holotype specimen: Son Hai, Ninh Phuoc, Ninh Thuan Province, central Vietnam, 21

Jan. 1993, deposited in the Herbarium of Fisheries Resources, Faculty of Agriculture, Kyoto University (KYA 930201). Isosyn-type specimens will be distributed to SAP and UC.

Other specimens examined: Nha Trang, Khanh Hoa Province, central Vietnam, 21 Mar. 1992, deposited in the Herbarium of Fisheries Resources, Faculty of Agriculture, Kyoto University.

Distribution: Endemic to central Vietnam. Remarks: *Sargassum* subgenus *Sargassum* includes the following 3 sections: *Zygocarpicae*, *Acanthocarpicae* and *Malacocarpicae* (Abbott *et al.* 1988). The section *Zygocarpicae* is characterized by bearing fertile older branchlets with receptacles provided with leaves and/or vesicles (Setchell 1935, Tseng *et al.* 1988). Two subsections, *Pseudozygocarpicae* and *Holozygocarpicae* can be recognized in *Zygocarpicae*. *Pseudozygocarpicae* presents pedicels of receptacles, and receptacles are provided with leaves, or receptacles provided with vesicles. On the other hand, *Holozygocarpicae* has no pedicel for the receptacle, and are provided with leaves, or with both leaves and vesicles (Tseng *et al.* 1988).

Sargassum denticarpum is characterized by the

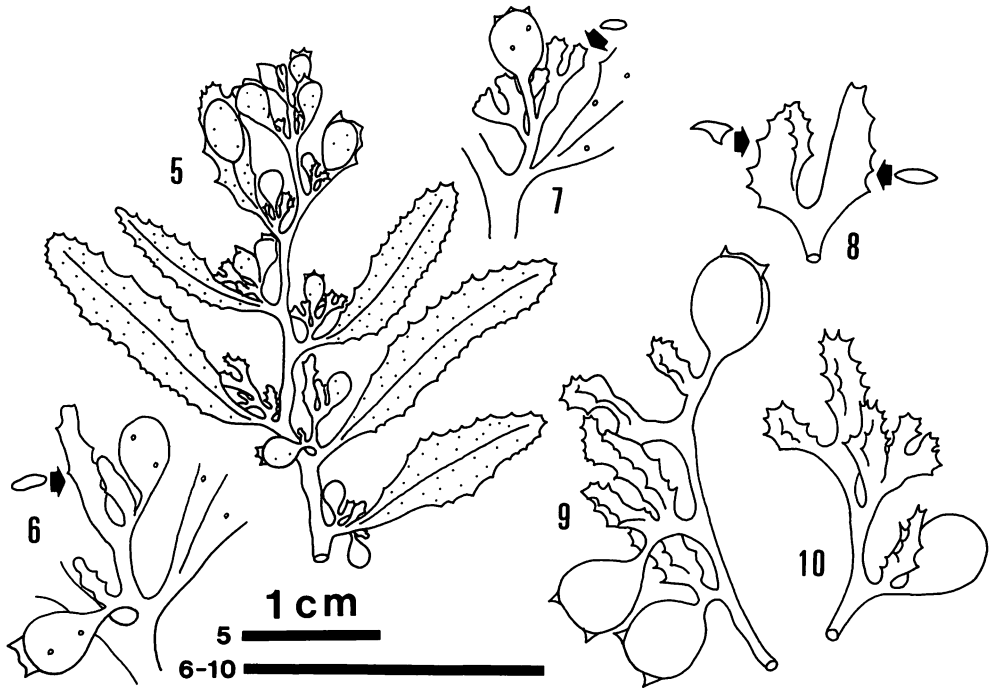


Fig. 5. Apical portion of a secondary branch of *S. denticarpum*, collected at Ninh Phuoc, 21 Jan. 1993.

Figs. 6-10. Compressed or triquetrous, pseudozygocarpic receptacles of *S. denticarpum* with dentate margins. Plants collected at Ninh Phuoc, 21 Jan. 1993.

androgynous receptacles, which are compressed or triquetrous and have a dentate margin, among the species of the subsection *Pseudozygocarpicae* (see the key to species described below). Although *S. bulbiferum* Yoshida and *S. incanum* Grunow also possessed androgynous receptacles, the former has a bulbous structure due to stunted main branches (Yoshida 1994) and the latter has fusiform receptacles with a smooth margin (Grunow 1915).

Key to species in subsection *Pseudozygocarpicae*

- 1. Plant androgynous 2
- 1. Plant dioecious 4
- 2. With bulbous structure by stunted main branches *S. bulbiferum*
- 2. Without bulbous structure 3
- 3. Receptacles terete to fusiform *S. incanum*
- 3. Receptacles compressed or triquetrous *S. denticarpum*
- 4. Male and female receptacles terete to

- 4. Male receptacles terete, female receptacles compressed 6
- 5. Leaves thicker, with cryptostomata *S. vachellianum*
- 5. Leaves thinner, without cryptostomata *S. graminifolium*
- 6. Upper leaves almost without vein, lower leaves with vein vanishing below the middle *S. cinereum*
- 6. Leaves with vein midway to well above the middle *S. glaucescens*

***Sargassum longifructum* Tseng et Lu (Figs. 11-22)**

Holdfast discoid to scutellate, up to 10 mm in diam. Stem erect, terete, up to 2 cm in height, up to 4 mm in diam., with a warty surface, bearing up to eight primary branches from the distal portion. Primary branches (Figs. 11, 12, 15 & 16) slender, terete, up to 50 cm long, up to 2 mm in diam., with a smooth surface. Secondary branches arising alternately at 5 cm interval, up to 25 cm long,

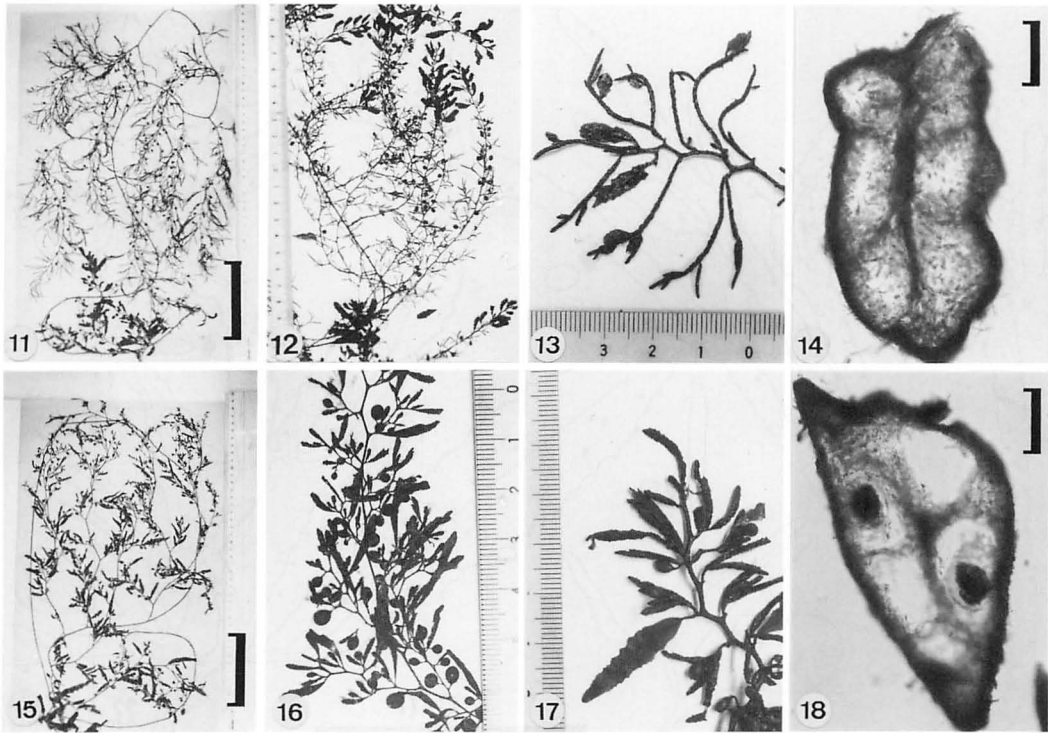


Fig. 11. Male plant of *Sargassum longifructum*, collected at Nha Trang, 4 Mar. 1992. Scale: 10 cm.

Fig. 12. Apical portion of secondary branches of *S. longifructum* (male plant), collected at Ha Tien, 5 Feb. 1993.

Fig. 13. Holozogocarpic, male receptacles of *S. longifructum*, collected at Ha Tien, 5 Feb. 1993.

Fig. 14. Transverse section of a male receptacle of *S. longifructum*, showing antheridial conceptacles. Plant collected at Nha Trang, 4 Mar. 1992. Scale: 200 μ m.

Fig. 15. Female plant of *S. longifructum*, collected at Nha Trang, 4 Mar. 1992. Scale: 10 cm.

Fig. 16. Apical portion of secondary branches of *S. longifructum* (female plant), collected at Ha Tien, 5 Feb. 1993.

Fig. 17. Holozogocarpic female receptacles of *S. longifructum*, collected at Ha Tien, 5 Feb. 1993.

Fig. 18. Transverse section of a female receptacle of *S. longifructum*, showing oogonial conceptacles. Plant collected at Nha Trang, 4 Mar. 1992. Scale: 200 μ m.

with a smooth surface. Leaves with a short petiole, simple or rarely once divided, elongate-lanceolate, up to 5 cm long, up to 13 mm wide, with a cuneate base and an acute apex; margin slightly to coarsely dentate; cryptostomata scattered or arranged in rows on the both sides of the midrib in linear leaves; midrib distinct, evanescent or percurrent (Figs. 12, 16 & 22). Vesicles spherical to ellipsoid, up to 7.5 mm long, up to 5 mm wide, with or without spinose or entire appendages at the apex, with inconspicuously scattered cryptostomata; stalk terete, up to 3 mm long (Figs. 19-22).

Plant dioecious. Male receptacles (Figs.

13, 14, 19 & 20) terete to slightly compressed, up to 30 mm long, up to 1 mm wide, simple or branched furcately once to several times, entire (Fig. 20) or sometimes with a few spines at the margin (Fig. 19), pseudozygocarpic (Fig. 20) to holozogocarpic (Figs. 13 & 19); only antheridial conceptacles found in the transverse section (Fig. 14). Female receptacles (Figs. 17, 18, 21 & 22) compressed or triquetrous, sometimes twisted, up to 6 mm long, up to 2 mm wide, simple or furcate, with a dentate margin, pseudozygocarpic (Fig. 21) or holozogocarpic (Figs. 17 & 22); only oogonial conceptacles found in the transverse section (Fig. 18).

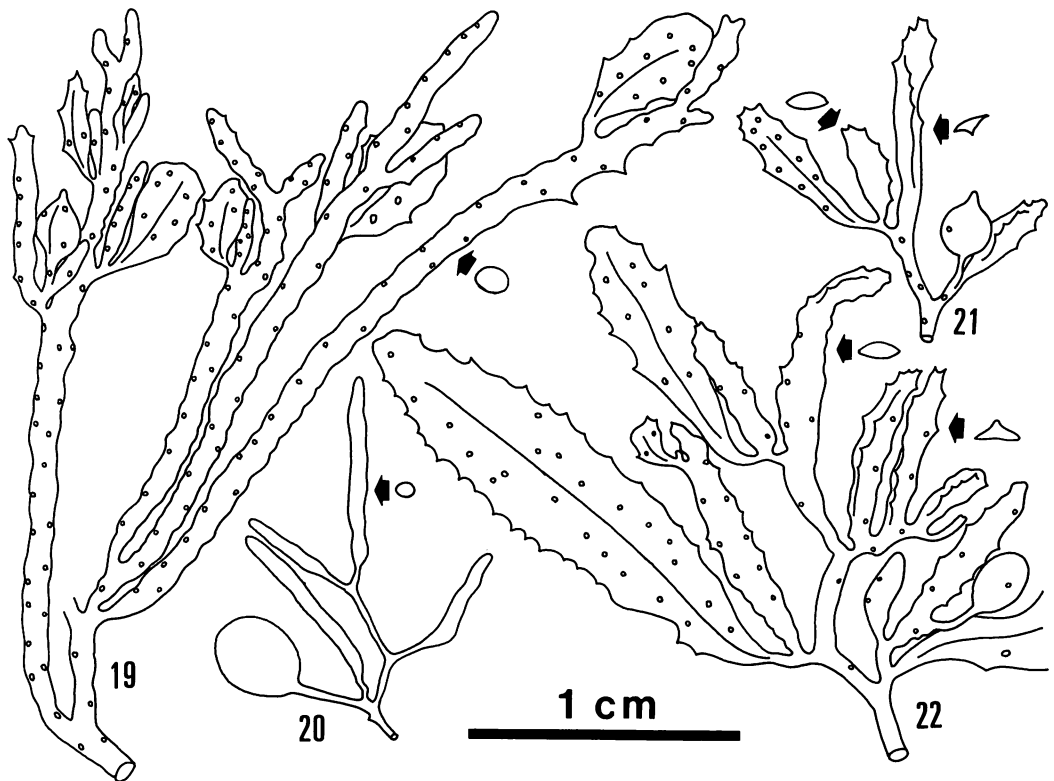


Fig. 19. Long, terete, holozygocarpic, male receptacles of *S. longifructum* with smooth surface or with a few spines. Plant collected at Ha Tien, 5 Feb. 1993.

Fig. 20. Short terete, pseudozygocarpic, male receptacles of *S. longifructum* with smooth surface. Plant collected at Nha Trang, 4 Mar. 1992.

Fig. 21. Compressed or triquetrous, pseudozygocarpic, female receptacles of *S. longifructum*, collected at Nha Trang, 4 Mar. 1992.

Fig. 22. Compressed or triquetrous, holozygocarpic, female receptacles of *S. longifructum*, collected at Ha Tien, 5 Feb. 1993.

Specimens greenish brown when dried.

Specimens examined: Mui Nia, Ha Tien, Kien Giang Province, southern Vietnam, 5 Feb. 1993, and Cauda Nha Trang, Khanh Hoa Province, central Vietnam, 4 May 1992, deposited in the Herbarium of Fisheries Resources, Faculty of Agriculture, Kyoto University.

Distribution: Naozhou Island (type locality) in southern China, Okinawa in Japan and Vietnam.

Remarks: Vietnamese specimens have the dioecious, pseudozygocarpic or holozygocarpic receptacles. Female receptacle is compressed or triquetrous with a dentate margin; male

receptacle is usually very long, terete or sometimes slightly compressed, with an entire margin or sometimes a few marginal spines. The characteristics of male plants have been found in *S. longifructum* collected from Naozhou Island, southern China (Tseng and Lu 1987, 1988). However, as this species was described on the basis of male material only, the above is the first description of the female receptacle characteristics (Table 1). In this table, vesicles from Chinese specimen are 1–2 mm in diameter, and seem to be much smaller than vesicles of the Vietnamese specimens. However, Chinese holotype specimen (AST 551767), which we observed, was a mature plant, possessing secondary or tertiary vesicles only. These were usually 3–5 mm in

Table 1. A comparison of *Sargassum longifructum* from China and Vietnam

	China (TSENG et LU, 1987)	Vietnam (present paper)
Holdfast	unknown	discoid to scutellate
Stem	terete	terete
height	up to 6 mm	up to 2 cm
Primary branch	terete	terete
length	up to 39 cm	up to 50 cm
Leaves	lanceolate	lanceolate
length	up to 6 cm	up to 5 cm
width	up to 7 mm	up to 1.3 cm
Vesicles	spherical to ovate	spherical to ellipsoid
size	1–2 mm in diam.	7.5 mm × 5 mm (max.)
apex	round or apiculate	round or apiculate
stalk	terete to foliaceous	terete
Receptacles	dioecious	dioecious
male morphology	terete	terete to slightly compressed
length	up to 4 cm	up to 3 cm
margin	entire	entire or with a few spines
female morphology	unknown	compressed to triquetrous
length	unkown	up to 6 mm
margin	unkown	dentate

diameter by our estimation. Furthermore, we can see the vesicles which are 3–4 mm in diameter even in Fig. 25 of Tseng et Lu (1988). On the other hand, in the Vietnamese specimen we observed many plants, at several stages of development, from young to mature. We found the largest dimension (7.5 mm × 5 mm) in their primary vesicles, but usually they were 3–7 mm in length in their vesicles on secondary and tertiary branches. When the male receptacles of the holotype specimen were also examined, they were not always holozygocarpic, and sometimes pseudozygocarpic. They were usually terete without spines, but sometimes slightly compressed with a few spines near their apex.

Nguyen (1986b) reported on zygocharpae species, *S. vietnamense* Zinova et Nguyen from Quang Ninh, northern Vietnam. The male receptacle is longer than the female one and branches alternately, compressed with a dentate margin. The female receptacle is unbranched, terete or compressed or triquetrous, with a dentate margin. Male receptacles are holozygocarpic and provided with leaves, or provided with vesicles. However,

female receptacles are pseudozygocarpic. It seems to be easy to distinguish *S. vietnamense* from the male plant of *S. longifructum* by the latter's terete and longer male receptacles. However, in Vietnamese populations, the receptacles of *S. longifructum* were sometimes pseudozygocarpic (plants from Nha Trang, Figs. 20 & 21) and sometimes holozygocarpic (plants from Ha Tien, Figs. 19 & 22). Furthermore, though male receptacles were usually terete, without spines (Fig. 20), they were sometimes slightly compressed at the apices with a few spines (Fig. 19). Usually in *Sargassum*, these characteristics may be variable within the populations and/or even in one plant. We should re-examine these variations for the morphological characteristics of *S. vietnamense*.

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鯨坂哲朗*・Huynh, Q. N.**・Nguyen, H. D.** : *Sargassum denticarpum* Ajisaka sp. nov.

and *S. longifructum* Tseng et Lu : ベトナム産ホンダワラ属(褐藻綱)で、
生殖器床に気胞が混在する 2 種

ホンダワラ亜属の *Zygocarpicae* 節(褐藻類, ホンダワラ科, ホンダワラ属)に属する 2 種をベトナムから初めて報告する。*Sargassum denticarpum* Ajisaka sp. nov. は、気胞と混在する雌雄同株・同床の生殖器床をもつが、それらは扁平で、縁辺に歯状突起がある。本種はベトナム特産種である。*Sargassum longifructum* Tseng et Lu は、気胞と混在する雌雄異株の生殖器床をもつ。今回初めて観察された雌性生殖器床は扁平で縁辺に歯状突起がある。雄性生殖器床は円柱状か、またはやや扁平で、縁辺が全縁あるいはわずかに刺をもつ。(*606 京都市左京区北白河追分町 京都大学農学部熱帯農学専攻, **Nha Trang Institute of Material Science, Center for Science, Production of Seaweed, 2-Hung Vuong, Nha Trang, Vietnam)

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