

SOME NEW SPECIES AND RECORDS OF *SARGASSUM* (SARGASSACEAE, PHAEOPHYTA) FROM THE CHINA SEA

C.K. Tseng and Lu Baoren

Abstract

Three new species of *Sargassum*, namely *S. weizhouense* Tseng et Lu, *S. capitatum* Tseng et Lu, and *S. ilicifolioides* Tseng et Lu, are discussed, and a new combination is made, namely *S. euryphyllum* (Grunow) Tseng et Lu. These 4 and *S. bulbiferum* Yoshida are all new records for China.

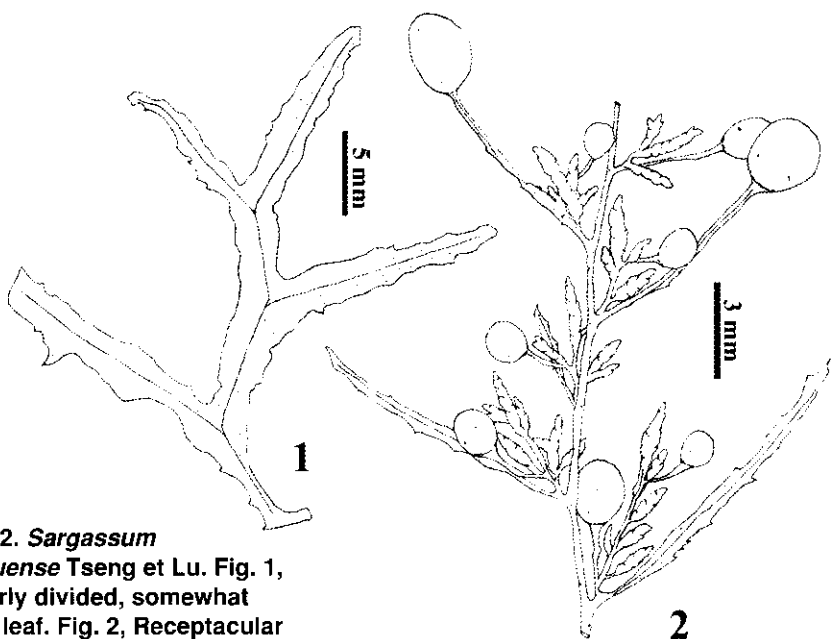
Introduction

Sargassum, especially the subgenus *Sargassum*, is a predominantly tropical and strongly subtropical genus and is very well represented in the Indo-Pacific region. When W. A. Setchell came to Hong Kong in 1929, he was surprised at the wealth of *Sargassum* species of this island; in a single drift on the beach, he found more than 10 species. He asked 2 young botanists in the area, Dr. Herklots of Hong Kong University and Prof. McClure of Lingnan University, to keep on searching for *Sargassum* specimens, and he finally published several articles enumerating 13 species (Setchell 1931a, 1931b, 1933, 1935, 1936). In the summer of 1942, a few months before his death, Setchell encouraged one of us (Tseng) to keep on with *Sargassum* studies because Setchell believed that many more species were present in this region. Although I (Tseng) returned to China in late 1946, I was unable to take up this study. I began to concentrate on *Sargassum* in 1965–1966, was interrupted by the "Cultural Revolution," and resumed the studies in 1970. Since then, Lu Baoren and I have written 36 articles or chapters describing 7 new species of *Sargassum*: 16 published in Chinese, 16 published in English, and 4 in press. In this chapter, we publish 4 more new species from China. Together with the published species, China has now 130 species of *Sargassum*.

Descriptions of the Species

Sargassum weizhouense Tseng et Lu, sp. nov.
(Figs. 1–5)

Frons lutea brunnea, 100 cm ultra alta. Haptero disciformi, 1 cm diametro. Ramis primariis et secundariis complanatas ad subcylindricis, cum aliquando spinis. Foliis primariis lanceolatis aliquando divisis pinnatim, 5–7 cm longis, 4–6 mm latis, acutis ad extremum, cuneatis vel oblique at basim, costis conspicuus percurrentibus, cryptostomatibus disperses ad utroque costalis, dentatibus ad margines; foliis secundariis similitudo ad foliis primariis, solum brevis, aliquando divisis, 4–5 cm longis, 3–5 mm latis; foliis ramulis angustis lanceolatis ad linearis,



Figs. 1–2. *Sargassum weizhouense* Tseng et Lu. Fig. 1, Irregularly divided, somewhat pinnate leaf. Fig. 2, Receptacular branchlets with receptacles, "leaves," and vesicles.



Fig. 3. Habit of *Sargassum weizhouense* Tseng et Lu. Note radial branching pattern.

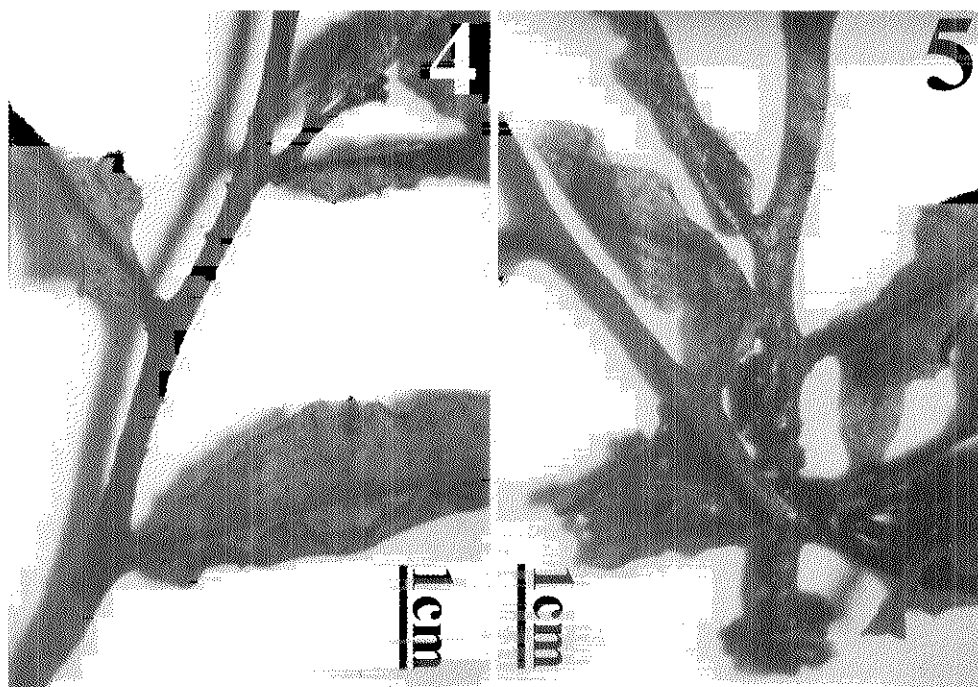


Fig. 4. Small spines on stem of *Sargassum weizhouense* Tseng et Lu. Fig. 5. Holdfast, stem, and main axis at base of plant of *Sargassum weizhouense* Tseng et Lu.

non lobatis, 3–6 cm longis vel plus, 1.5–2 cm latis. Vesiculis sphaeris vel ovatis, 1.5–3 mm diametro.

Planta androgyna. Receptaculis conicis, verrucosis, 1.5–2 mm longis, 0.8–1 mm diametro. Holozygocarpicae.

Holotype. AST 55-1828, collected by Zhang Junfu and Xu Fali, April 26, 1955, at Weizhou Island, Guangxi Province.

Fronds yellowish brown, more than 100 cm tall. Holdfast discoid, 1 cm in diameter. Main axis cylindrical, short, glabrous, about 5 mm long, 4 mm in diameter. Several primary branches arising from the upper part of the axis, compressed to subcylindrical, usually spinous, about 100 cm long, 2 mm in diameter. Secondary branches cylindrical, about 18–30 cm long, 1.5 mm in diameter, arising from leaf axils of the primary branches, similar to primary branches in shape, only shorter, slightly spinous on the surface, alternate, at intervals of 2–3 cm. Ultimate branchlets cylindrical with a few cryptostomata, 10–15 cm long, 1–1.5 mm in diameter, beset with leaves, vesicles, and receptacles. Leaves on primary branches with short compressed leaf stalk, about 1–2 mm long, lanceolate, 1–2 times pinnately divided, 5–7 cm long, 4–6 mm wide, acute at the apex, cuneate or

slightly oblique at the base, dentate at the margins, with distinct, percurrent midrib and conspicuous cryptostomata irregularly scattered on both sides of the midrib. Leaves on secondary branches similar to those on the primary branches in shape, shorter and more slender, sometimes divided, 4–5 cm long, 3–5 mm wide. Leaves on ultimate branchlets narrowly lanceolate to linear, 3–6 cm or more long, 1.5–2 mm wide, usually 20–30 times as long as wide, dentate at the margins, with percurrent midrib and cryptostomata arranged on both sides of the midrib. Vesicles spherical or ovate, 1.5–3 mm in diameter, with some cryptostomata, stalks mostly cylindrical, 3–9 mm long, 0.3–0.5 mm in diameter, sometimes flattened or foliaceous, with midribs and cryptostomata, denticulate at the margins, 15–20 mm long.

Plants androgynous. Receptacles conical, simple, 1–2 times furcated, verrucose on the surface, about 1.5–2 mm long, 0.8–1 mm in diameter, sometimes holozygocarpic.

Holotype: AST 55-1828, collected by Zhang Junfu and Xu Fali, on April 26, 1955, at Weizhou Island, Guangxi Province.

Other Material Examined: From Weizhou Island: AST 55-1829, 55-1893, 55-1896, 55-1922a, 55-1923, 55-1935, 87-1260, 87-1329, 87-1330, 96-0002, 96-0003, 96-0043, 96-0051, 96-0052, 96-0053, 96-0065, 96-0076, and 96-0077.

Habitat: Growing on subtidal rocks, usually 1–2 m under water.

Remarks: *Sargassum weizhouense* Tseng et Lu is characterized by its discoid holdfast; compressed to subcylindrical primary branches, usually spinous on the surface; leaves usually divided 1–2 times; and androgynous, holozygocarpic, conical receptacles, usually with a small leaf or vesicle. This species is related to *S. bulbiferum* Yoshida, but *S. weizhouense* does not have bulbs on the basal parts of the primary branches, and its primary and secondary branches usually have a spinous surface.

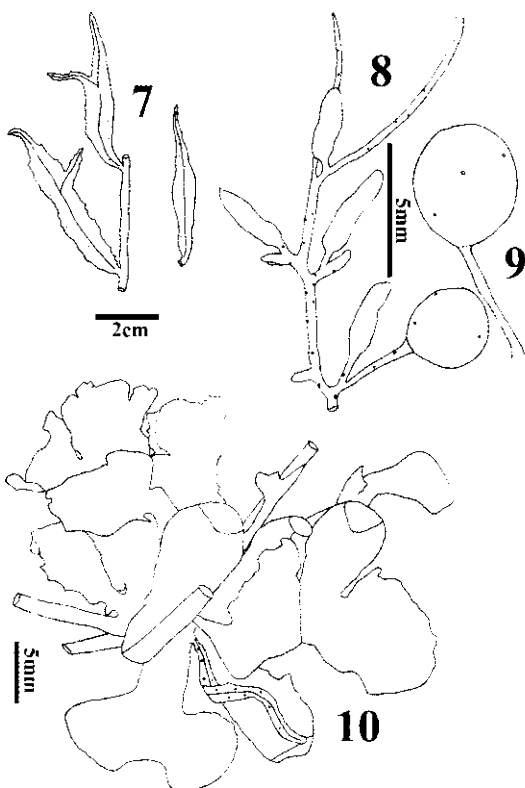
Sargassum bulbiferum Yoshida, Jpn. J. Phycol. 42:48, figs. 9–11.
(Figs. 6–10)

Fronds yellow-brown, attaining a height of more than 100 cm, holdfast discoid, verrucose on the surface, up to 1.2 cm in diameter. Axis cylindrical, glabrous or somewhat warty, up to 10 mm long, 2 mm in diameter. Primary branches thick and compressed, about 8–10 mm long, 3–5 mm wide, 3–5 arising radially from upper parts of the axis, lower parts of branches compressed, upper parts cylindrical, glabrous, up to 100 cm or more long, 2 mm wide, often with several bulbs at the base of the primary branches. Secondary branches arising from foliar axils of the primary branches, at intervals of 2–4 cm, alternate, cylindrical, glabrous, about 10–14 cm long, 1–1.2 mm in diameter. Ultimate branches short and slender, glandular, about 3–4 cm long, less than 1 mm in diameter, beset with leaves, vesicles, and receptacles. Leaves on primary branches elongatedly lanceolate, sometimes linear, once forked, about 3–7 cm long, 3–8 mm wide, acute at the



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Fig. 6. Habit of Chinese specimen of *Sargassum bulbiferum* Yoshida, originally described from central Japan in the Sea of Japan.



Figs. 7-10. *Sargassum bulbiferum* Yoshida. Fig. 7, Shapes of 3 "leaves." Fig. 8, Elongate receptacles with "leaves" and vesicles. Fig. 9, Vesicle with nearly spherical shape and a few cryptostomata. Fig. 10, A group of bulbs (stunted structures) at the base of a primary branch.

apex, cuneate at the base, with conspicuous percurrent midrib and a few cryptostomata scattered throughout the surface, irregularly dentate or entire at the margins. Leaves on secondary branches similar to those on primary branches in shape, but smaller, about 4–5 cm long, 2–3 mm wide. Leaves on ultimate branchlets linear or narrowly lanceolate, not forked, about 2–3 cm long, 1–2 mm wide, acute at the apex, slightly obliquely cuneate at the base. Vesicles spherical or obovate-rounded at the apex, up to 3 mm in diameter, with a few cryptostomata and slender, terete, filamentous stalks, up to 8 mm long, less than 0.5 mm in diameter.

Plants androgynous. Receptacles cylindrical, glabrous, verrucose on the surface, oogonia mainly gathered on the upper parts of the receptacles, spermatangia mainly on the lower parts, about 7–8 mm long, 0.8–1 mm in diameter, once or twice forked, pseudozygocarpic.

Habitat: Growing on subtidal rocks.

Distribution in China: AST 55-1830 and 55-1922, collected by Zhang Junfu and Xu Fali, April 1955, at Weizhou Island, Guangxi Province; AST 55-2041, collected by Zhang Junfu and Xu Fali, May 1955, at Weizhou Island, Guangxi Province.

Geographical Distribution. Japan and China.

Remarks: Our specimens collected at Weizhou Island were carefully compared with the description and figures of *S. bulbiferum* published by Yoshida (1994, p. 48, figs. 9–11), particularly the bulbs at the base of the primary branches and the forked leaves. In 1999, at the workshop meeting in Vietnam, we showed a specimen (AST 55-2041) to Dr. Yoshida, and he agreed with our determination. We are grateful to Dr. Yoshida for his help. This species is recorded for the first time from China.

Sargassum capitatum Tseng et Lu, sp. nov.

(Figs. 11, 12, 15–17)

Frons cinerea, 24 cm alta, haptero disciformi, 1.5 cm diametro. Axes cylindricis, furcatis. Ramis primariis complanatis, glabris, bulbis, 23 cm longis, 2 mm latis. Ramulis brevibus, cylindricis, 1–1.5 mm longis, 1 mm diametro. Foliis cineris, elongatis lanceolatis, crassiusculis, aliquando divisis, 8 cm longis, 10 mm latis, acutis apicibus, obliques cuneatis ad basim, costis conspicuus, percurrentibus, cryptostomatibus dispersim ad utroque costalis, maximum partem undulatis ad margines. Vesiculis sphaericis vel ovatis, 3–4 mm diametro, aliquot cryptostomatibus.

Planta androgyna. Receptaculis cylindricis furcis at apicibus, 5 mm longis, 1 mm diametro. Pseudozygocarpaceae.

Holotype: AST 59-3586, collected by Yang Zondai and Li Xiaoyi, July 5, 1959, at Dacheng Island, Zhejiang Province.

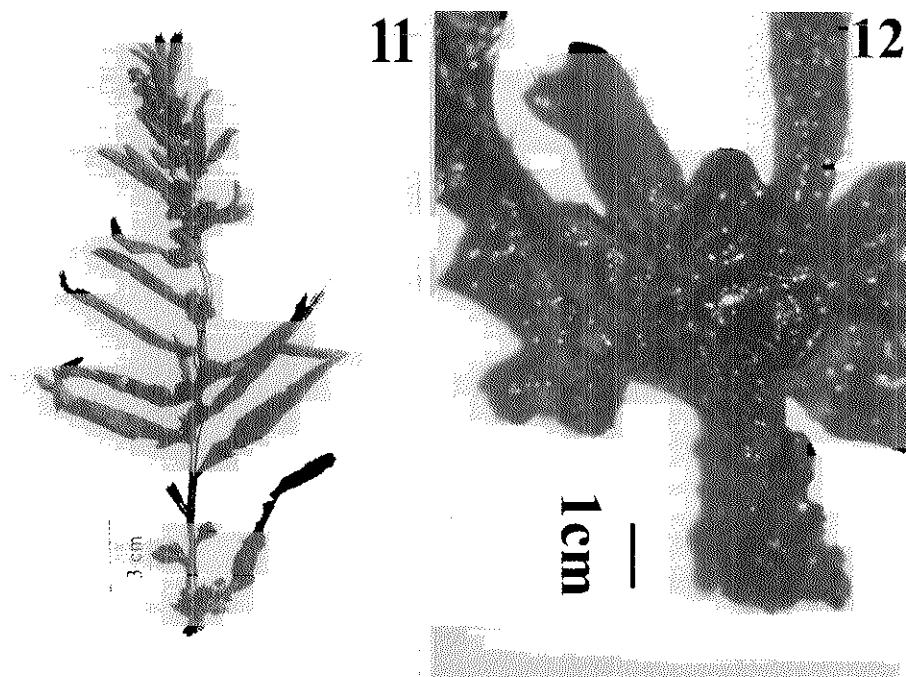
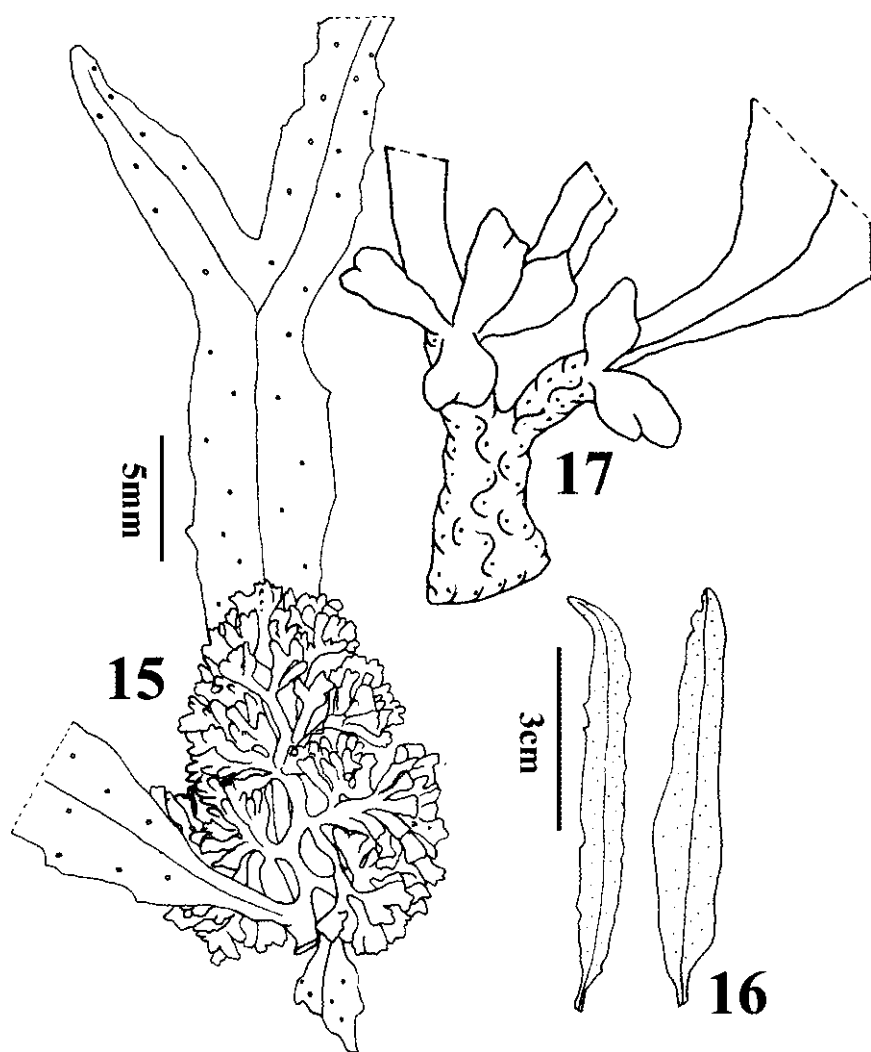


Fig. 11. Habit of holotype specimen of *Sargassum capitatum* Tseng et Lu. Fig. 12. Basal part of *Sargassum capitatum* Tseng et Lu, including holdfast, divided main axis, and bulbs.

Fronds with blue-gray cast, up to 24 cm tall. Holdfast discoid, 1.5 cm in diameter. Main axis cylindrical, usually divided at the top, up to 1.5 cm long, 3 mm in diameter, with warty surface. Primary branches arising from the upper parts of the main axis, compressed, glabrous on the surface, up to 23 cm tall, 2 mm wide, with several bulbs at the base. Fertile branchlets very short, arising from foliar axils of the primary branches, 1–1.5 cm long, 1 mm in diameter, beset with leaves, vesicles, and receptacles. Leaves with blue-gray cast, thick and large, elongatedly lanceolate, sometimes divided, up to 8 cm long, 10 mm wide, acute at the apex, slightly obliquely cuneate at the base, with conspicuous percurrent midribs and a few cryptostomata irregularly arranged on both sides of the midribs; leaves mostly entire at the margins, or denticulate at the middle and upper parts of the margins, generally leaves on lower parts of plant larger than leaves on upper parts, similar to each other in shape. Vesicles spherical or ovate, rounded at the apex, 3–4 mm in diameter, with compressed and glabrous stalks 3 mm long, and a few cryptostomata.

Plants androgynous. Receptacles cylindrical, verrucose on the surface, usually forked, particularly at the apex, 5 mm long, less than 1 mm in diameter, several receptacles compound, racemosely arranged, pseudozygocarpic.



Figs. 15–17. *Sargassum capitatum* Tseng et Lu. Fig. 15, Furcate “leaf” and densely branched receptacular branch. Fig. 16, Two lanceolate “leaves.” Fig. 17, Divided main axis with bulbs.

Holotype: AST 59-3586, collected by Yang Zondai and Li Xiaoyi, July 5, 1959, at Dacheng Island, Zhejiang Province.

Other Material Examined: AST 59-3454, collected at Beiji Island, Weizhou City; AST 59-3850, collected at Beiyushan Island, Xiang County; and AST 63-4497, collected at Nanji Islands.

Habitat: Growing on lower intertidal to subtidal rocks.

Remarks: *Sargassum capitatum* is characterized by its usually divided main axis; compressed primary branches with thick, large, elongately lanceolate, sometimes forked, blue-gray leaves; the presence of bulbous structures at the base of primary branches; and androgynous, pseudozygocarpic, cylindrical, verrucose receptacles that are compound and arranged in a panicle. It is closely related to *S. bulbiferum* Yoshida. However, *S. bulbiferum* does not have a divided main axis; large and thick leaves, mostly entire at the margins; or paniculate receptacles.

Sargassum euryphyllum (Grunow) Tseng et Lu, comb. nov.
(Figs. 13, 18–20)

Basionym: *Sargassum ilicifolium* (Turner) C. Agardh var. *euryphylla* Grunow, Verh. K.-K. Zool.-Bot. Gesell. Wien 65:404, 1915.

Fronds yellow-brown, reaching a height of more than 100 cm. Holdfast discoid. Axis cylindrical, very short, up to 5 mm tall, glabrous. Primary branches arising radially from the upper parts of the axis, subcylindrical, more than 100 cm long, 3 mm in diameter, glabrous on the surface. Secondary branches arising from foliar axils of the primary branches, at intervals of 4–6 cm, alternate, cylindrical, glabrous, up to 20 cm long, 2 mm in diameter. Ultimate branchlets shorter and more slender, cylindrical, with a few plain glandular dots on the surface, up to 6 cm long, 1 mm in diameter, beset with leaves, vesicles, and receptacles. Leaves on primary branches large, oblong, up to 4.5 cm long, 16 mm wide, rounded at the apex, obliquely asymmetrically cuneate at the base, usually larger abaxially than adaxially, without conspicuous midrib, midrib vanishing on lower parts of the leaves, slightly raised conspicuous cryptostomata, irregularly arranged on both sides of the midrib, dentate at the margins. Leaves on secondary branches oblong, slightly shorter, up to 4 cm long, 10 mm wide. Leaves on ultimate branches usually obovate, upper parts larger than lower parts, about 2–3 cm long, 4–5 mm wide, with conspicuous cryptostomata arranged on both sides of the midrib. Vesicles spherical, sometimes opposite, up to 6 mm in diameter, generally 4 mm in diameter when young, with a few slightly raised cryptostomata on the surface, and cylindrical stalks, 3 mm long, 1 mm in diameter.

Plants dioecious. Female receptacles when very young and male receptacles cylindrical, glabrous, up to 4 mm long, 1 mm in diameter, usually forked, racemosely arranged on the fertile branches, pseudozygocarpic.

Distribution in China: Qinglanglang, Xinying, and Sanya, Hainan Island.

Geographical Distribution: Red Sea, China

Habitat: Growing on lower intertidal rocks.

Remarks: Some specimens of *Sargassum* collected from Hainan Island (AST 57-5897, 57-5898, 57-5920, 63-2383, and 92-0247) agree with the description of *S. ilicifolium* (Turner) C. Agardh var. *euryphylla* Grunow (Grunow 1915, p. 404). We carefully compared specimens from Hainan Island with *S. ilicifolium* (Turner)

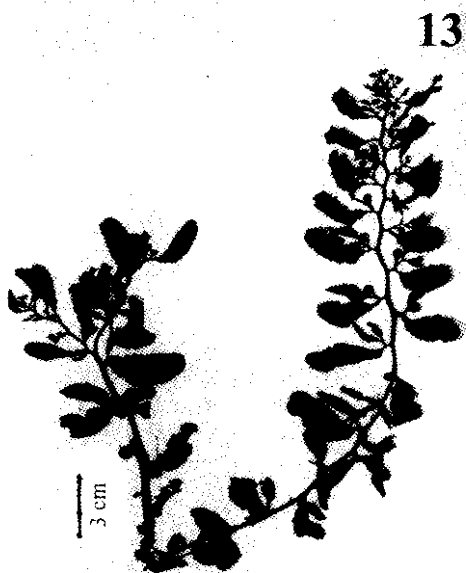
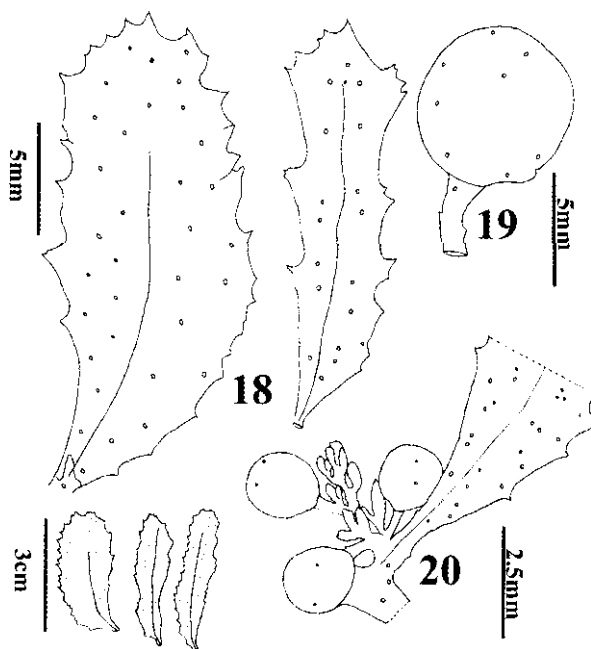


Fig. 13. Habit of Chinese specimen of *Sargassum euryphyllum* (Grunow) Tseng et Lu.



Figs. 18–20. *Sargassum euryphyllum* (Grunow) Tseng et Lu. Fig. 18, “Leaves” on primary (2 at top of figure) and secondary (3 at bottom of figure) branches. Fig. 19, Vesicle with rather stout cylindrical stalk. Fig. 20, Vesicles mixed with male receptacles.

C. Agardh and found marked differences. Our specimens have large, oblong leaves, spherical vesicles, and no earlike structures on both sides. Female receptacles are very young; male receptacles are glabrous, cylindrical, and pseudozygocarpic. *Sargassum ilicifolium*, however, has small elongated, ellipsoidal leaves, spherical vesicles with an earlike structure on both sides, and very simple receptacles: "receptaculis femineis brevibus, fastigiato racemosis, minute denticulatis." Therefore, we decided to elevate the variety *euryphylla* Grunow of *S. ilicifolium* (Turner) C. Agardh to *S. euryphyllum* (Grunow) Tseng et Lu.

Sargassum ilicifolioides Tseng et Lu, sp. nov.
(Figs. 14, 21–24)

Misapplied Name: *Sargassum ilicifolium* of Tseng et Lu, Stud. Mar. Sinica 12:5, pl. 3, 1978.

Frons lutea brunnea, ramis primariis subcylindricis, 45 cm longis, 2 mm diametro; ramis secundariis cylindricis, 12 cm longis, 1.5 mm diametro, elevatis glandibus; ramulis parvis, elevatis glandibus, 5 cm longis, 1 mm latis; foliis ramulis lanceolatis, 1.5 cm longis, 4 mm latis. Vesiculis sphaericis, elevatis cryptostomatibus, structuris auriculatibus utroque.

Planta androgyna. Receptaculis complanatis, spinis, furcatis saepe, 2–4 mm longis, 1–1.5 mm latis.

Holotype: AST 76-1239, collected by Lu Baoren, March 20, 1976, at Chenhang Island, Xisha Islands.

Fronde yellow-brown. Primary branches subcylindrical, glabrous, arising radially from upper parts of the axis, up to 45 cm long, 2 mm in diameter. Secondary branches cylindrical, up to 12 cm long, 1.5 mm in diameter, arising from foliar axils of primary branches, with a few raised glandular dots, at intervals of 2–4 cm, alternate. Ultimate branchlets cylindrical, slender and shorter, up to 5 cm long, 1 mm in diameter, with dense, raised glandular dots, beset with leaves, vesicles, and receptacles. Leaves on primary and secondary branches obovate or ellipsoidal, rounded at the apex, obliquely asymmetrically cuneate at the base, up to 2 cm long, 10 mm wide, with nonpercurrent, conspicuous midrib, midrib usually vanishing in the middle parts of the leaves, and conspicuous cryptostomata, slightly raised on the surface, dentate at the margins. Leaves on ultimate branchlets lanceolate, smaller, up to 1.5 cm long, 4 mm wide, acute at the apex, symmetrical, cuneate at the base, with conspicuous midrib, midrib usually vanishing below the apex, with conspicuously raised cryptostomata, irregularly arranged on both sides of the midrib, sharply dentate at the margins, with filamentous stalks with a few raised cryptostomata. Vesicles spherical and small, 3–5 mm in diameter, with a few raised cryptostomata, rounded at the apex, with earlike structures on both sides, and mostly cylindrical, sometimes compressed or flattened, stalks.

Plants androgynous. Receptacles compressed, spinous at the apex and

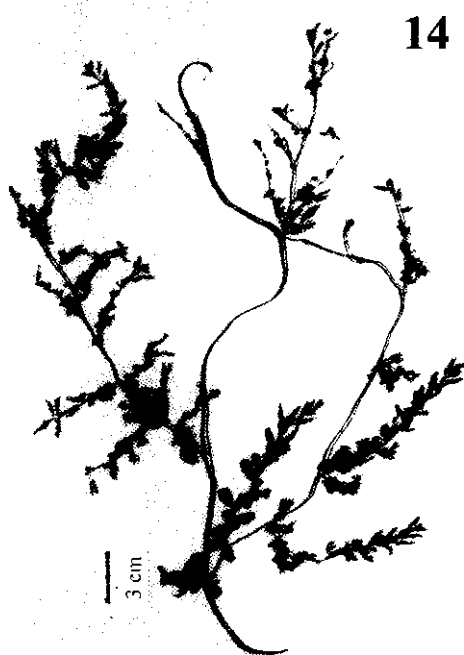
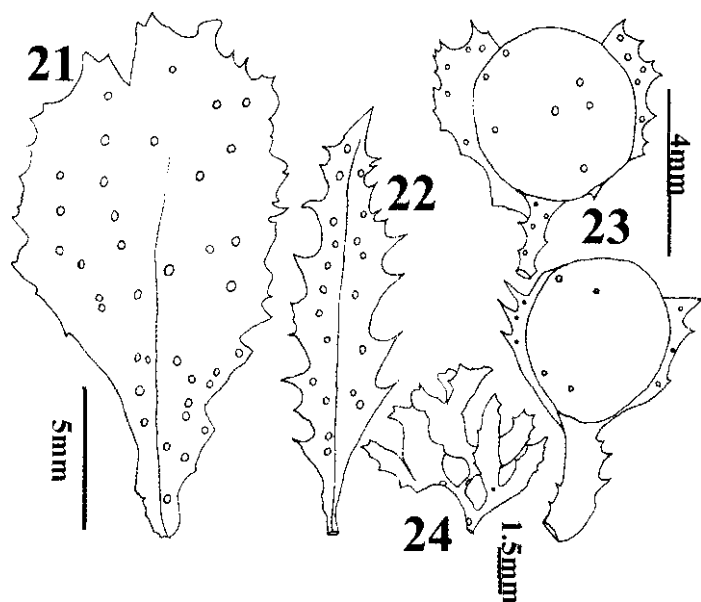


Fig. 14. Habit of the holotype of *Sargassum ilicifolioides* Tseng et Lu.



Figs. 21–24. *Sargassum ilicifolioides* Tseng et Lu. Fig. 21, “Leaf” of primary branch. Fig. 22, “Leaf” of ultimate branch. Fig. 23, Vesicles with earlike appendages and cylindrical to compressed stalks. Fig. 24, Compressed, branched vesicles.

laterally, often once to twice forked, about 2–4 mm long, 1–1.5 mm wide, several receptacles racemosely arranged on the fertile branches, odontocarpic.

Holotype: AST 76-1239, drifted ashore, collected by Lu Baoren, March 20, 1976, at Chenhang and Xisha Islands.

Other Materials Examined: AST 76-0886, from Guangjin Island, Xisha Islands, and AST 76-1242, from Chenhang Island, Xisha Islands.

Remarks: *Sargassum ilicifolioides* Tseng et Lu is principally characterized by its secondary and ultimate branches with raised glandular dots on the surface; 2 kinds of leaves, obovate or ellipsoidal on the primary and secondary branches and lanceolate on the ultimate branches; and androgynous, compressed and spinous receptacles, racemosely arranged on fertile branchlets. It is closely related to *S. ilicifolium* (Turner) C. Agardh, but *S. ilicifolium* does not have raised glandular dots on the branches of the secondary and ultimate branches; 2 kinds of leaves, obovate or ellipsoidal on primary and secondary branches and lanceolate on the ultimate branches; or androgynous receptacles.

We (Tseng and Lu 1978, p. 5) published "*Sargassum ilicifolium*" collected from Xisha Islands on the basis of specimens with acanthocarpic androgynous, compressed receptacles, single, once or twice divided. Our identification was based entirely on the description of Grunow: "receptaculis ancipitibus, androgynis racemoses vel racemosocymosis, masculis hinc inde longioribus, omnibus acute spinosis." Yoshida (1988) reported *S. ilicifolium* from Taiwan, only with male receptacles. Japanese phycologists, including Dr. Yoshida, told us that *S. ilicifolium* is dioecious. Dr. Yoshida checked our specimen and agreed with our determination. In recent years, in studying the subsection *Biserrulae* of *Sargassum*, we have come to think that the algae, although very primitive plants, have a clear distinction between different sexual stages and should not have both androgyny and dioecism in the same species. Therefore, after careful study, we found the real female plants of *S. ilicifolium* and compared them with those of *S. ilicifolioides*. We find that these 2 species are conspicuously different individual species.

Conclusion

In this chapter, we report 5 new records for the algal flora of China. Of these, 3 are new species: the holozygocarpic species *S. weizhouense* Tseng et Lu, the pseudozygocarpic species *S. capitatum* Tseng et Lu, and *S. ilicifolioides* Tseng et Lu. *Sargassum euryphyllum* (Grunow) Tseng et Lu is a new combination. *Sargassum bulbiferum* of Tseng et Lu is simply a new record. We (Tseng and Lu 1988) have reported 17 species of zygocarpic *Sargassum* in China, and together with the 4 species just reported, the total is 21 zygocarpic *Sargassum* species for China. *Sargassum ilicifolioides* Tseng et Lu was formerly erroneously identified by Tseng et Lu (1999) as *S. ilicifolium* belonging to the series *Odontocarpae* (*Coriifoliae*) of biserrulic *Sargassum*.

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