

# Brown Algae from the Hachijōjima Island, Izu Islands, Japan

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**Abstract.** Twenty three species and one variety of brown algae (Phaeophyceae) were reported from the shores of Hachijōjima Island, Izu Islands, Japan. Eleven species belonged to the Dictyotales (47.8%) and five to the Fucales (21.7%). No kelp species (Laminariales) were observed. Consequently, the seaweed community of Hachijōjima is considered as typical of subtropical one. *Sphacelaria californica*, *Sphacelaria yamadae* and *Spatoglossum latum* are new records for the island.

**Key words:** brown algae, Hachijōjima Island, Phaeophyceae, *Spatoglossum latum*, *Sphacelaria californica*, *S. yamadae*.

## Introduction

Brown algae (Phaeophyceae, Ochrophyta, kingdom Chromista) are one of the most important components of coastal marine communities (both in terms of productivity and biomass). Compared to red (Rhodophyta) and green seaweeds (Chlorophyta), (both belonging to the kingdom Plantae), the species richness and distribution of the Phaeophyceae has been understudied in the Izu Islands.

Hachijōjima Island is situated in the center of the Izu Islands, exposed the warm Kuroshio current. Marine algal flora of Hachijōjima Island had been investigated by several botanists since the early days of the history of Japanese phycology. In 1918, Kintaro Okamura, the ‘Father’ of Japanese Phycology, visited this island. After receiving a large number of specimens from Tadashi Fudita and Harutoshi Yoshikawa from their visit to the island in 1928, Okamura published a list of the marine algae of the island consisting of 102 species including sixteen brown algae (Okamura, 1930). He noted ‘Preceding my visit, no one had collected any algae in that island.’ Indeed, although seven botanists including Samuro Ohkubo, Kotaro Saida and Mitsutaro Shirai visited the island in May 1887 and collected dozens of ma-

rine algae (Ohkubo, 1887), no material was studied in detail until Okamura started his phycological works in 1889. In the algal herbarium of the National Museum of Nature and Science (TNS) there are only two sheets of red algal specimens collected by Shirai in Hachijōjima Island and identified by Okamura, who noticed that “the late Dr. Shirai was the first Japanese collector in the Izu Islands” (Okamura, 1935). After Okamura’s death, his student, Yukio Yamada (1952) and Yamada’s student, Sokichi Segawa (1952, 1953) studied the marine algal flora of the island. As a result Yamada (1955) recorded over a hundred species of marine algae including 28 brown algae. During the past half century, there have been few of studies on the island except reports by Ohba *et al.* (1998) collecting 119 species of marine algae (21 brown algae) and Sato (2005) recording 85 species (13 brown algae) so far.

In order to make comparative studies on the distribution and potential changes in the marine algal flora of the Sagami Sea, a survey of the flora of Izu and Ogasawara archipelagoes was undertaken during 2006–2010. In this survey entitled “Study on Environmental Changes in the Sagami Sea and Adjacent Coastal Area with Time Serial Comparison of Fauna and Flora”, I investigated brown algal flora on the coasts of Hachijōjima Is-

land and Chichijima Island. In this paper, 23 species and one variety of phaeophycean algae obtained from the Hachijōjima Island are presented.

### Materials and Methods

The samples of brown algae were collected from both intertidal zone and subtidal zone by walking and snorkelling. The collections were carried out at four sites along the island: (1) Kaminato (33°07'49"N, 139°48'24"E), 25 February 2009, 27 March 2010; (2) Nazumado (33°08'43"N, 139°44'21"E), 25 February 2009, 26 February 2009, 28 March 2010; (3) Sokodo (33°07'28"N, 139°49'03"E), 26 February 2009, 28 March 2010; (4) Yaene (33°05'55"N, 139°46'16"E), 26 February 2009, 27 March 2010. Collected specimens were fixed in 10% Formalin-seawater within 2 hours. Identification at the species level of both dried specimens and liquid-preserved specimens were made. Voucher specimens were deposited in the algal herbarium of the National Museum of Nature and Science (TNS). In the present paper, orders and families were classified, according to Norris (2010) and nomenclatural treatment of species names referred mainly to Silva *et al.* (1996), Guiry and Guiry (2010) and Yoshida (2010).

### Results

#### A list of brown algae collected from Hachijōjima Island

Class **Phaeophyceae** Kjellman in Engler et Prantl  
Order **Sphacelariales** Migula  
Family **Sphacelariaceae** Decaisne

1. *Sphacelaria californica* Sauvageau ex Setchell et N.L. Gardner (Fig. 1) [Japanese name: Hane-gunsen-kurogashira]  
*Sphacelaria plumura* Zanardini var. *californica* Sauvageau, J. Bot., 14: 91. f. 21 (1901) [type locality: San Diego, California].  
*Sphacelaria californica* Sauvageau ex Setchell et N.L. Gardner, Univ. Calif. Publ. Bot., 8: 395, pl. 37, f. 23–27 (1925).

Specimen examined. Nazumado, 28 Mar. 2010 (TNS-AL 171368).

Distribution. Hokkaido, Honshū, Kyūshū; Korea, China, California, Baja California, Mexico, South Australia.

Remarks. The plants were epilithic on rocks in the subtidal zone. Although *Sphacelaria californica* has incomplete pinnate erect filaments as a character of the species, the plants from the island had no pinnate ramifications. I identified this by only the shape of mature propagules with large lateral apical cells (Fig. 1 arrowheads). Kitayama (1994, p. 57) observed this pattern in plants of the species cultured in 20°C in short day (8:16h light: dark) condition. This is the first record of the species from Izu Islands.

2. *Sphacelaria rigidula* Kützinger (Fig. 2) [Jn.: Waijigata-kurogashira]

*Sphacelaria rigidula* Kützinger, Phycologia Generalis: 292 (1843) [type locality: Red Sea, Egypt].

Specimen examined. Nazumado, 28 Mar. 2010 (TNS-AL 171369).

Distribution. Hokkaido, Honshū, Kyūshū; Cosmopolitan.

Remarks. Plants were epilithic on rocks in the subtidal zone.

3. *Sphacelaria yamadae* Segawa (Figs. 3, 8) [Jn.: Tsukubane-kurogashira]

*Sphacelaria yamadae* Segawa, Sci. Pap. Inst. Algal. Res. Hokkaido Univ., 2: 256. f. 4 (1941) [type locality: Arashidomari, Shimoda, Japan].

Specimen examined. Nazumado, 28 Mar. 2010 (cast ashore, TNS-AL 171370).

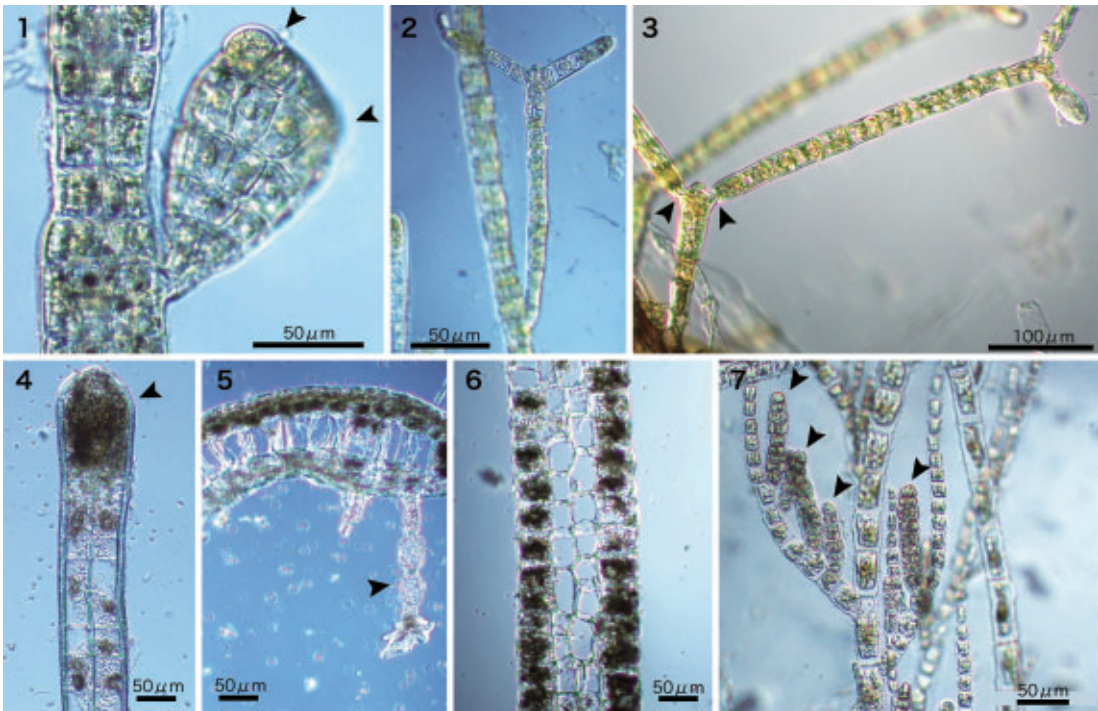
Distribution. Honshū, Shikoku, Kyūshū; Korea.

Remarks. Plants were epiphytic on *Sargassum* spp. This species differs from the other Sphacelarian species by having constrictions at the base (Fig. 3 arrowheads) on the arms of propagules. This is the first record of the species from Izu Islands.

Order **Dictyotales** Kjellman  
in Engler et Prantl, 1896

Family **Dictyotaceae** J.V. Lamouroux ex  
Dumortier, 1822

4. *Dictyopteris prolifera* (Okamura) Okamura (Fig. 9) [Jn.: Hera-yahazu]  
*Haliseris prolifera* Okamura in De Toni et Okamura, Ber. Deut. Bot. Ges., 12: 74. pl. 16, f. 1–5 (1894) [type locality: Japan].  
*Dictyopteris prolifera* (Okamura) Okamura, Rec. Oceanogr. Works Japan, 2: 102 (1930).  
Specimens examined. Yaene, 26 Feb. 2009 (TNS-AL 171371, 171372).  
Distribution. Southern Honshū, Shikoku, Kyūshū; Korea; China.
5. *Dictyopteris undulata* Holmes (Fig. 10) [Jn.: Shiwa-yahazu]  
*Dictyopteris undulata* Holmes, Linn. J. Bot., 31: 251. pl. 8, f. 1 (1896) [type locality: Misaki, Kanagawa, Japan].  
Specimens examined. Nazumado, 28 Mar. 2010 (TNS-AL 171375); Sokodo, 28 Mar. 2010 (TNS-AL 171373, 171374).  
Distribution. Honshū, Shikoku, Kyūshū, Nansei Is.; Korea, China, Taiwan.
6. *Dictyota coriacea* (Holmes) I.-K. Hwang, H.-S. Kim et W.J. Lee (Fig. 11) [Jn.: Sanadagusa]  
*Glossophora coriacea* Holmes, J. Linn. Soc. Bot., 31: 251 (1896) [type locality: Enoura (Odawara, Kanagawa?), Japan].  
*Dictyota coriacea* (Holmes) I.-K. Hwang, H.-S. Kim et W.J. Lee, Algae, 19: 189 (2004).  
Specimens examined. Kaminato, 27 Mar. 2010 (TNS-AL 171383, 171384); Nazumado, 25 Feb. 2009 (TNS-AL 171379, 171380), 28 Mar. 2010 (TNS-AL 171381, 171382); Sokodo, 26 Feb. 2009 (TNS-AL 171376, 171377), 28 Mar. 2010 (TNS-AL 171378).  
Distribution. Southern Hokkaido, Honshū, Shikoku, Kyūshū; Korea, China, Taiwan; California, México.  
Remarks. Plants were epiphytic on *Sargassum* spp.
7. *Dictyota dichotoma* (Hudson) J.V. Lamouroux (Fig. 12) [Jn.: Amijigusa]  
*Ulva dichotoma* Hudson, Flora angelica: 476 (1762) [type locality: Walney Island, Lancashire, England].  
*Dictyota dichotoma* (Hudson) J.V. Lamouroux, J. de Bot., 2: 42 (1809).  
Specimens examined. Sokodo, 28 Mar. 2010 (TNS-AL 171385, 171386).  
Distribution. Hokkaido, Honshū, Shikoku, Kyūshū, Nansei Isl.; Korea, China, Taiwan, Philippines, Vietnam; Cosmopolitan.
8. *Dictyota dichotoma* (Hudson) J.V. Lamouroux var. *intricata* (C. Agardh) Greville (Fig. 13) [Jn.: Kazuno-amiji]  
*Zonaria dichotoma* var. *intricata* C. Agardh, Species Algarum ...: 134 (1820) [type locality: Cádiz, Spain].  
*Dictyota dichotoma* (Hudson) J.V. Lamouroux var. *intricata* (C. Agardh) Greville, Algae Britannicae ...: 58 (1830).  
Specimens examined. Nazumado, 28 Mar. 2010 (TNS-AL 171387); Sokodo, 28 Mar. 2010 (TNS-AL 171388).  
Distribution. Honshū, Kyūshū, Nansei Isl.; Korea, China, Philippines; Pacific Ocean, Indian Ocean, Atlantic Ocean.  
Remarks. De Clerck (2003) treated “*Dictyota divaricata*”, which have narrow dichotomies at wide angles, as a synonym of *Dictyota dichotoma* var. *intricata* in the basis of his molecular studies.
9. *Dictyota linearis* (C. Agardh) Greville (Fig. 14) [Jn.: Ito-amiji]  
*Zonaria linearis* C. Agardh, Species Algarum, 1: 134 (1821) [syntype locality: Cádiz, Spain].  
*Dictyota linearis* (C. Agardh) Greville, Algae britannicae: 43 (1830).  
Specimens examined. Sokodo, 28 Mar. 2010 (TNS-AL 171389, 171390).  
Distribution. Hokkaido, Honshū, Shikoku, Kyūshū, Nansei Isl.; Korea, China, Taiwan, Philippines, Vietnam; Cosmopolitan.
10. *Distromium decumbens* (Okamura) Levring



Figs. 1–7. Brown algae from Hachijōjima Island. 1, *Sphacelaria californica* (TNS-AL 171368). A mature propagule showing lateral apical cells (arrowheads); 2, *Sphacelaria rigidula* (TNS-AL 171369). A bifurcate propagule; 3, *Sphacelaria yamadae* (TNS-AL 171370). A mature propagule showing constrictions at the base of arm (arrowheads); 4, *Distromium decumbens* (TNS-AL 171391). Transverse section of marginal portion of the distromatic thallus with an apical cell (arrowhead); 5, *Lobophora variegata* (TNS-AL 171394). Transverse section of the middle portion of the prostrate thallus with moniliform rhizoid cells (arrowheads); 6, *Spatoglossum latum* (TNS-AL 171411). Transverse section of the middle portion of frond showing one cortical cell layers and a 2 medullary cell layer; 7, *Hincksia michellae* (TNS-AL 171414). Erect filaments with elongate-cylindrical plurilocular sporangia (arrowheads).

Figs. 8–29. Brown algae from Hachijōjima Island (dried specimens). 8, *Sphacelaria yamadae* (TNS-AL 171370). Plants epiphytic on the vesicle of *Sargassum* spp.; 9, *Dictyopteris prolifera* (TNS-AL 171372); 10, *Dictyopteris undulata* (TNS-AL 171374); 11, *Dictyota coriaceum* (TNS-AL 171376); 12, *Dictyota dichotoma* (TNS-AL 171386); 13, *Dictyota dichotoma* var. *intricata* (TNS-AL 171387); 14, *Dictyota linearis* (TNS-AL 171389); 15, *Distromium decumbens* (TNS-AL 171392); 16, *Lobophora variegata* (TNS-AL 171394); 17, *Padina arborescens* (TNS-AL 171396); 18, *Rugulopteryx okamurae* (TNS-AL 171400); 19, *Spatoglossum latum* (TNS-AL 171411); 20, *Zonaria diesingiana* (TNS-AL 171408); 21, *Hincksia michellae* (TNS-AL 171414); 22, *Colpomenia sinuosa* (TNS-AL 171416); 23, *Hydroclathrus clathratus* (TNS-AL 171417); 24, *Petalonia binghamiae* (TNS-AL 171418); 25, *Sargassum duplicatum* (TNS-AL 171421); 26, *Sargassum hemiphyllum* (TNS-AL 171426); 27, *Sargassum nipponicum* (TNS-AL 171428); 28, *Sargassum patens* (TNS-AL 171434); 29, *Sargassum piluliferum* (TNS-AL 171440).



(Figs. 4, 15) [Jn.: Futae-ogi]

*Chlanidote decumbens* Okamura, Bot. Mag. Tokyo, 13: 38, f. 23–25 (1899) [type locality: Chiba, Japan].

*Distromium decumbens* (Okamura) Levring, K. Fysiogr. Sällsk. Lund Förhandl., 10: 5 (1940).

Specimens examined. Sokodo, 28 Mar. 2010 (TNS-AL 171391); Yaene, 27 Mar. 2010 (TNS-AL 171392).

Distribution. Southern Honshū, Shikoku, Kyūshū; Korea, Vietnam.

11. *Lobophora variegata* (J.V. Lamouroux) Womersley ex E.C. Oliveira (Figs. 5, 16) [Jn.: Hai-ogi]

*Dictyota variegata* J.V. Lamouroux, J. Bot., Desvauz, 2: 40 (1809) [type locality: Antilles, West Indies].

*Lobophora variegata* (J.V. Lamouroux) Womersley ex E.C. Oliveira, Algas marin. bentôn. Brasil, 217 (1977).

Specimens examined. Nazumado, 28 Mar. 2010 (TNS-AL 171393, 171394).

Distribution. Southern Honshū, Kyūshū, Nansei Isl., Ogasawara Isl.; China, Taiwan, Philippines, Vietnam; Cosmopolitan.

12. *Padina arborescens* Holmes (Fig. 17) [Jn.: Umi-uchiwa]

*Padina arborescens* Holmes, Linn. J. Bot., 31: 251, pl. 12, f. 1 (1896) [type locality: Enoshima, Kanagawa, Japan].

Specimens examined. Nazumado, 28 Mar. 2010 (TNS-AL 171395); Yaene, 26 Feb. 2009 (TNS-AL 171396)

Distribution. Honshū, Shikoku, Kyūshū; Korea, China, Taiwan.

13. *Rugulopteryx okamuræ* (E.Y. Dawson) I.-K. Hwang, W.J. Lee et H.-S. Kim (Fig. 18) [Jn.: Fukurin-amiji]

*Dilophus okamuræ* E.Y. Dawson, Bull. Torrey Bot. Club, 77: 86 (1950) [type locality: Nomo, Nagasaki, Japan].

*Rugulopteryx okamuræ* (E.Y. Dawson) I.-K. Hwang, W.J. Lee et H.-S. Kim in Hwang, Lee,

Kim et De Clerck, Phycologia, 48: 5, f. 1–49 (2009).

Specimens examined. Kaminato, 25 Feb. 2009 (TNS-AL 171397, 171398), 27 Mar. 2010 (TNS-AL 171399, 171400); Nazumado, 28 Mar. 2010 (TNS-AL 171401); Sokodo, 26 Feb. 2009 (TNS-AL 171402, 171403), 28 Mar. 2010 (TNS-AL 171404, 1714105).

Distribution. Honshū, Shikoku, Kyūshū; Korea, China, Taiwan.

14. *Spatoglossum latum* J. Tanaka (Figs. 6, 19) [Jn.: Hiroha-komongusa]

*Spatoglossum latum* J. Tanaka, Korean J. Phycol., 7: 28, f. 1–19 (1992) [type locality: Shimoda, Shizuoka, Japan].

Specimens examined. Nazumado, 25 Feb. 2009 (TNS-AL 171411), 28 Mar. 2010 (TNS-AL 171412).

Distribution. Central Honshū, Kyūshū; endemic to Japan.

Remarks. The plants were so young that the blades were under 1 cm in width, however, a size of 3–8 cm in width is considered to be characteristic of the species (Tanaka and Yoshida in Yoshida, 1998). This is the first record of this species from Hachijōjima Island, though the alga listed in Yamada (1955) as “*Spatoglossum* sp. n.” may be identical to the present species. In Izu Islands this species has been recorded from Niijima Island, Shikinejima Island (Tanaka, 1992), Kozu Island (Kitayama, 2002).

15. *Zonaria diesingiana* J. Agardh (Fig. 20) [Jn.: Shima-ogi]

*Zonaria diesingiana* J. Agardh, Linnaea, 15: 443 (1841) [type locality: Australia].

Specimens examined. Sokodo, 26 Feb. 2009 (TNS-AL 171406), 28 Mar. 2010 (TNS-AL 171407, 171408); Yaene, 26 Feb. 2009 (TNS-AL 171409), 27 Mar. 2010 (TNS-AL 171410).

Distribution. Southern Honshū, Kyūshū, Nansei Islands; Korea, China, Taiwan, Philippines, Australia.

Order **Ectocarpales** Setchell et N.L. Gardner  
Family **Acinetosporaceae** Hamel ex J. Feldmann

16. ***Hincksia mitchellae*** (Harvey) P.C. Silva (Figs. 7, 21) [Jn.: Tawaragata-shiwomidoro]

*Ectocarpus mitchellae* Harvey, Smithon. Contr. Knowl., 3: 143. pl. 12G. (1852) [type locality: Nantucket, Massachusetts, U.S.A.].

*Hincksia mitchellae* (Harvey) P.C. Silva in P.C. Silva, Meñez et Moe, Smithon. Contr. Marine Science, 27: 73 (1987).

Specimens examined. Kaminato, 25 Feb. 2009 (TNS-AL 171413, 171414).

Distribution. Hokkaido, Honshū, Nansei Isls.; Cosmopolitan.

Remarks. Plants were epiphytic on thalli of *Sargassum patens*.

#### Family **Scytosiphonaceae** Farlow

17. ***Colpomenia sinuosa*** (Mertens ex Roth) Derbès et Solier (Fig. 22) [Jn.: Fukuronori]

*Ulva sinuosa* Mertens ex Roth, Catalecta botanica, 3: 327, pl. 12, f. a (1806) [type locality: near Cádiz, Spain].

*Colpomenia sinuosa* (Mertens ex Roth) Derbès et Solier in Castagne, Supplément au catalogue des plantes qui croissant naturellement ...: 95 (1851).

Specimens examined. Kaminato, 27 Mar. 2010 (TNS-AL 171415, 171416); Sokodo, 26 Feb. 2009 (TNS-AL 171443, 171444).

Distribution. All of Japan; Cosmopolitan.

18. ***Hydroclathrus clathratus*** (C. Agardh) M. Howe (Fig. 23) [Jn.: Kagomenori]

*Encoelium clathratum* C. Agardh, Species algarum ..., 1: 412 (1823) [type locality: uncertain].

*Hydroclathrus clathratus* (C. Agardh) M. Howe, Bahama Flora, 590 (1920).

Specimens examined. Sokodo, 26 Feb. 2009 (TNS-AL 171417); Yaene, 26 Feb. 2009 (TNS-AL 171445).

Distribution. Southwestern Hokkaido, Honshū, Shikoku, Kyūshū, Nansei Isls.; Cosmopolitan.

19. ***Petalonia binghamiae*** (J. Agardh) K.L. Vinogradova (Fig. 24) [Jn.: Habanori]

*Endarachne binghamiae* J. Agardh, Acta Reg. Soc. Physiogr. Lund, 7: 27 (1896) [type locality: California, U.S.A.].

*Petalonia binghamiae* (J. Agardh) K.L. Vinogradova, Nov. Syst. Plant. Non Vasc., 10: 31 (1973).

Specimens examined. Nazumado, 26 Feb. 2009 (TNS-AL 171418, 171419); Sokodo, 28 Mar. 2010 (TNS-AL 171420).

Distribution. Hokkaido, Honshū, Shikoku, Kyūshū, Nansei Isls.: Korea, China, Taiwan, California, México, Australia.

#### Order **Fucales** Kylin

##### Family **Sargassaceae** Kützting

20. ***Sargassum duplicatum*** Bory de Saint-Vincent (Fig. 25) [Jn.: Futaemoku]

*Sargassum duplicatum* Bory de Saint-Vincent, Voyage autour du monde ..., 127 (1828) [type locality: Pacific Ocean].

Specimens examined. Nazumado, 25 Feb. 2009 (TNS-AL 171421, 171422), 28 Mar. 2010 (TNS-AL 171423); Yaene, 26 Feb. 2009 (TNS-AL 171424, 171425).

Distribution. Pacific coast of Central and Southern Honshū, Kyūshū, Nansei Isls.; China, Taiwan, Philippines, Vietnam, Malaysia, Tahiti.

Remarks. Mattio *et al.* (2009) regarded this species as a synonym of *Sargassum ilicifolium* (Turner) C. Agardh in the basis of their molecular studies.

21. ***Sargassum hemiphyllum*** (Turner) C. Agardh (Fig. 26) [Jn.: Isomoku]

*Fucus hemiphyllus* Turner, Fuci ..., 3: 86, pl. 167 (1811) [type locality: Port Nagasaki, Japan].

*Sargassum hemiphyllum* (Turner) C. Agardh, Species algarum ..., 1: 39 (1820).

Specimen examined. Nazumado, 28 Mar. 2010 (TNS-AL 171426).

Distribution. Honshū, Shikoku, Kyūshū; Korea, China.

22. *Sargassum nipponicum* Yendo (Fig. 27) [Jn.: Tamanashimoku]

*Sargassum nipponicum* Yendo, J. Coll. Sci. Imp. Univ. Tokyo, 21(12): 153, pl. 17, f. 11–16 (1907) [type locality: Ōshima, Wakayama, Japan].

Specimens examined. Nazumado, 25 Feb. 2009 (TNS-AL 171427, 171428), 26 Feb. 2009 (TNS-AL 171429); Sokodo, 26 Feb. 2009 (TNS-AL 171430, 171431), 28 Mar. 2010 (TNS-AL 171432, 171433).

Distribution. Pacific coast of the southern part of Japan. Endemic to Japan.

23. *Sargassum patens* C. Agardh (Fig. 28) [Jn.: Yatsumatamoku]

*Sargassum patens* C. Agardh Species algarum ..., 1: 27 (1820) [type locality: Japan].

Specimens examined. Nazumado, 25 Feb. 2009 (TNS-AL 171434), 26 Feb. 2009 (TNS-AL 171435, 171436), 28 Mar. 2010 (TNS-AL 171437, 171438).

Distribution. Honshū, Shikoku, Kyūshū, Nansei Isls.; Korea, China.

Remarks. Yamada (1955) listed probably this species as “*Sargassum patens* f. *pinnatifidum*.”

24. *Sargassum piluliferum* (Turner) C. Agardh (Fig. 29) [Jn.: Mametawara]

*Fucus pilulifer* Turner, Fuci ..., 1: 145, pl. 65 (1808) [type locality: Nagasaki, Japan].

*Sargassum piluliferum* (Turner) C. Agardh, Species algarum ..., 1: 27 (1820).

Specimens examined. Nazumado, 25 Feb. 2009 (TNS-AL 171439, 171440), 28 Mar. 2010 (TNS-AL 171441, 171442).

Distribution. Central and Southern Honshū, Shikoku, Honshū, Kyūshū; Korea, China, Philippines, Vietnam, Bangladesh, Sri Lanka.

## Discussion

Twenty three brown algal species of five families were found on the shores of Hachijōjima Island. Species richness in brown algae was not as high as expected. For comparison, a previous sur-

vey in the Suzaki Imperial Villa (a smaller area, on the Izu Islands) revealed forty seven species (Kitayama, 2006). A potential reason is that Hachijōjima Island is a solitary oceanic and volcanic island, remotely distant from the Izu Peninsula, situated 200 km to the north. The brown algal flora of the island can be regarded as subtropical. Indeed, among the twenty three species obtained during the present survey, eleven species (47.8%) were Dictyotales and five species (21.7%) were Fucales (all belonging to the Sargassaceae family), whilst no kelp species (Laminariales) could be found. In Asia the majority of Sargassaceae are distributed from temperate to tropical areas, while most of the species of Laminariales are distributed to temperate to subarctic areas. Arasaki (1976) formulated the “L/F ratio”, or ratio of Laminariales to Fucales as a biogeographical indicator using marine algal flora. In this survey the L/F ratio of this island was 0, characteristic of subtropical areas. However, the absence of warm temperate species of kelps, such as *Ecklonia cava* Kjellman, *Eckloniopsis radicata* (Kjellman) Okamura and *Undariopsis peterse-niana* (Kjellman) Miyabe et Okamura could also be the result of the isolation of Hachijōjima (as well as the relatively recent formation of the island by volcanic activity), from the closest areas where such kelp species are distributed (islands in the Sagami Sea and the Izu Peninsula). In fact, for example, *Eckloniopsis radicata* (Kjellman) Okamura, a warm temperate kelp species endemic to Japan, has no distribution to the most of islands in the Izu Islands except for Ōshima Islands and Shikine Islands, which are the closest from the Izu Peninsula.

When studying his material, Okamura (1930) concluded that “Hatidyo has striking subtropical features in comparison with the remaining six islands”. In addition, Segawa (1953) proposed the name of the “Okamura line” for the frontier separating the area between Mikurajima and Hachijōjima Island, according to Okamura (1930). I agree with their conclusions. There seems to have been few changes in the brown algal flora during about the last 50 years.



In this study, the collections were partial in seasonality (I could not carry out collections in summer because of the weather conditions causing the flight and ship cancellation). For this reason, it is likely that some species previously recorded on the island half a century ago could not be observed during the present survey. Despite intense efforts, the following species were not observed: *Ishige okamurae* Yendo, *Ralfsia verrucosa* (Areschoug) Areschoug, *Dictyopteris plagio-gramme* (Montagne) Vickers, *Dictyopteris repens* (Okamura) Børgesen, *Homeostrichus flabellatus* Okamura, *Padina australis* Hauck, *Stypopodium zonale* (Lamouroux) Papenfuss, *Feldmannia irregularis* (Kützinger) Hamel, *Chnoospora implexa* J. Agardh, *Sargassum alternato-pinnatum* Yamada, *Sargassum crispifolium* Yamada, *Sargassum fulvellum* (Turner) C. Agardh, *Sargassum horneri* (Turner) C. Agardh. The present status of these species on Hachijōjima Island remains unknown. More research is required in order to characterize the present macroalgal communities of the Izu Islands.

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### References

- Arasaki, S., 1976. Sea weeds. In: *Marine Algae/Benthos* (Motoda, S.). *Basic Course of Marine Science* 5, pp. 1–147. Tokaidaigaku Shuppankai. Tokyo. (In Japanese.)
- De Clerck, O., 2003. The genus *Dictyota* (Dictyotales, Phaeophyta) in the Indian Ocean. *Opera Botanica Belgica*, 13: 1–205.
- Guiry, M.D. and Guiry, G.M. 2010. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 28 October 2010.
- Kitayama, T., 1994. A taxonomic study of the Japanese *Sphacelaria* (Sphacelariales, Phaeophyceae). *Bulletin of the National Science Museum, Tokyo*, Ser. B, 20: 37–141.
- Kitayama, T., 2002. Brown algae from Kozu Island, Izu Islands, Japan. *Memoirs of the National Science Museum, Tokyo*, (38): 65–70.
- Kitayama, T., 2006. Brown algae from the Suzaki Imperial Villa, Suzaki, Shimoda, Japan. *Memoirs of the National Science Museum, Tokyo*, (40): 7–21.
- Mattio, L., Payri, C.E. and Verlaque, M., 2009. Taxonomic revision and geographic distribution of subgenus *Sargassum* (Fucales, Phaeophyceae) in the western and central Pacific islands based on morphological and molecular analyses. *Journal of Phycology*, 45: 1213–1227.
- Norris, J.N., 2010. Marine algae of the Northern Gulf of California: Chlorophyta and Phaeophyceae. *Smithsonian Contributions to Botany*, 94: i–x, 1–276.
- Ohba, H., Hayashi, T., Kitazawa, A., Koike, Y., Ishimaru, T., and Murano, M., 1998. Survey of the benthic marine flora of Ogasawara Islands (Bonin Islands) and Hachijōjima Island, southern Japan. *Cruise Reports, Tokyo University of Fisheries*, (7): 155–157. (In Japanese.)
- Ohkubo, S., 1887. Izu Junto-ki. *Botanical Magazine (Tokyo)*, 1: 156–166. (In Japanese.)
- Okamura, K., 1930. On the algae from the Island Hatidyo. *Records of Oceanographic Works in Japan*, 2: 92–110, pls. 6–10.
- Okamura, K., 1935. A list of algae collected by the late Dr. K. Shirai. *Journal of Japanese Botany*, 11: 45–49. (In Japanese.)
- Sato, T., 2005. On the marine algae from Hachijo Island, Tokyo Metropolitan. *Report of Laboratory for Science Education, Faculty of Science, Hokkaido University*. 26 pp. (In Japanese.)
- Segawa, S., 1952. Studies on marine algae from Hachijo Islands. *Japanese Scientific Monthly*, 40 supplement: 35. (In Japanese.)
- Segawa, S., 1953. The position of Hachijō from the standpoint of the algal distribution. *Proceeding of 7th Pacific Scientific Congress*, 5: 20–23.
- Silva, P.C., P.W. Basson, and R.L. Moe. 1996. Catalogue of the Benthic Marine Algae of the Indian Ocean. *University of California Publications in Botany*, 79: xiv+1–1259.
- Tanaka, J., 1992. Morphology and taxonomy of *Spatoglossum latum* sp. nov. (Dictyotales, Phaeophyceae)

- from Japan. *Korean Journal of Phycology*, 7: 27–32.
- Yamada, Y., 1952. Studies on marine algae from Hachijo Islands and its adjacent area. *Japanese Scientific Monthly*, 40 supplement: 34–35. (In Japanese.)
- Yamada, Y., 1955. Studies on marine algae from Hachijo Island. *Report on development of marine resources, Japanese Society for Promotion of Science*, 38–40. (In Japanese.)
- Yoshida, T. 1998. *Marine Algae of Japan*. 1222 pp. Uchida Rokakuho, Tokyo (In Japanese.)
- Yoshida, T. and K. Yoshinaga, 2010. Check list of Marine Algae of Japan (Revised in 2005). *Japanese Journal of Phycology*, 58: 69–122. (In Japanese.)

## 八丈島の褐藻相

北山太樹

2009年2月と2010年3月に八丈島海岸の褐藻相を調査した結果、15科23種1変種が確認された。そのうち、温帯や熱帯に分布の中心をもつアミジグサ目が11種(47.8%)、ヒバマタ目が5種(21.7%)に達するのに対し、亜寒帯に多いコンブ目はまったく採取されず、当海域には亜熱帯性の性格の強い海藻相がみられることが示された。*Sphacelaria californica* ハネゲンセンクロガシラ(クロガシラ科)、*Sphacelaria yamadae* ツクバネクロガシラ(クロガシラ科)、*Spatoglossum latum* ヒロハコモンゴサ(アミジグサ科)は、八丈島で初めての記録になる。