

Morphological Study of the Marine Algal Genus *Padina* (Dictyotales, Phaeophyceae) from Southern Philippines: 3 Species New to Philippines

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This monographic study presents morphological descriptions of eight species of *Padina* collected from the Visayas and Mindanao regions of southern Philippines, including distributions of each species and a taxonomic key for all the species examined. Of these species, three are new records for the Philippines, namely: *P. fernandeziana* Skottsberg and Levring, *P. jonesii* Tsuda and *P. moffittiana* Abbott and Huisman. One species, *P. antillarum* (Kützinger) Piccone, represents a new nomenclatural record, which is applied to a Philippine species for the first time. Four species previously reported in the Philippines are reconfirmed and described *P. australis* Hauck, *P. minor* Yamada, *P. boryana* Thivy and *P. sanctae-crucis* Børgesen. All eight species studied have distromatic thalli, except for *P. antillarum* which is tetrastromatic. Three of these have indusiate sporangia, namely: *P. sanctae-crucis*, *P. moffittiana* and *P. fernandeziana*.

Key Words: Dictyotales, morphology, *Padina*, Phaeophyceae, taxonomy

INTRODUCTION

Species of the marine brown algal genus *Padina* are widely distributed throughout the tropics and are very easy to recognize in the field. However, infrageneric segregation requires morphological verification at the microscopic level. The “ear-like” blades have a circinnately inrolled apical margin (Womersley 1987; Lee and Kamura 1991; Huisman 2000), where a row of meristematic cells produces a thallus that is parenchymatous. Its frond typically consists of two or more layers of cells while the stipe is composed of four or more layers. The upper surface is calcified to varying degrees [this is also the side the margin rolls towards, see Trono (1969)], and the reproductive structures occur in bands on the upper and, sometimes, on the lower surface. Bands of phaeophycean hairs can also occur. The location and arrangement of the bands of reproductive structures and hairs are among the defining characters used in species discrimination, and which are usually associated with reproductive sori composed of antheridia, oogonia or tetrasporangia. These are either surrounded by an indusium or naked depending on the

species.

Padina shows an alternation of isomorphic generations, and is isogamous. Unlike many brown algae, *Padina* forms spores in clusters of four, similar to the patterns seen in red algae. According to the observation of Rengasamy (1990) and Allender (1977), the sporophytic phase is considerably more common than the gametophytic phase with as much as 86% sporophytes against 14% gametophytes in the field. The predominance of diploid sporophytes may be explained partly by tetraspore formation by apomeiosis as documented by Gaillard (1972).

Padina is the only genus of brown algae that is calcified (Allender and Kraft 1983; Fletcher 1987; Huisman 2000) until another calcified genus *Newhousia* was described by Kraft *et al.* (2004) from the reefs of Hawaii. In the erect to recumbent fan-like fronds of *Padina*, calcium carbonate in the form of aragonite is precipitated within the circinate apical portions and deposited as needles on either or both surface and noncrystalline blocks on the proximal dorsal surfaces (Miyata *et al.* 1977, Figs 3, 4).

There are about 50 taxa of *Padina* worldwide, although most are poorly known and many would prove to be synonymous (Lee and Kamura 1991). According to Guiry and Dhonncha (2003), only 30 of these are currently accepted. In the Philippines, 12 species have been

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documented by Silva *et al.* (1987). Most of these Philippine records are based on morphological examinations most likely based on a few characters which might be variable. Silva *et al.* (1987) did not verify any of these previous records through actual specimen examination, except to update the nomenclature using currently accepted names. Since the publication of the catalogue of Silva *et al.* (1987), it has been 18 years and there is a clear need to re-examine the various records in the light of recent taxonomic and nomenclatural developments.

Moreover, with the growing use of *Padina* species for heavy metal biosorption in the case of *P. pavonica* (Linnaeus) Thivy (Raize 2003) and for environmental remediation like *P. boergesenii* Allender and Kraft (Dulymamode *et al.* 2001), it is becoming very important to study its taxonomy as different species may have different physico-chemical composition that will in turn affect their physiological performance. For a technology deficient country like the Philippines, naturally-occurring seaweeds like *Padina* could be employed as a possible environmental bioindicator in place of expensive technology not available within the country. Thus, it is necessary to conduct a more thorough study of the Philippine species using currently accepted taxonomic characters in order to provide and update baseline information. A sound and stable taxonomic knowledge of the various species will provide the framework against which its economic utilization can be determined.

MATERIALS AND METHODS

Specimens were collected from different intertidal locations in the Visayas and Mindanao, including few locations in Luzon, Philippines. Standard collecting and preserving procedures follow those of Tsuda and Abbott (1985). One set of specimens was placed in a plastic bottle or bag with 5% formalin/seawater solution. Another set of specimens were pressed as herbarium samples. All collected specimens were deposited in the USC Biology Department herbarium for safekeeping.

Permanent transverse and longitudinal sections of important structures (Figs 2, 3; sporangia, gametangia, sterile thallus parts, and the base of the thallus) were made of every species. The set of specimens preserved in formalin was used. However, in cases where only dried herbarium material was available, small thallus fragment were rehydrated in a detergent solution for several

weeks. Prior to dehydration the thallus was stained overnight in a Petri dish using Safranin plant stain. Small pieces of thallus were dehydrated in alcohol using 10-20% increments (30%, 50%, 70%, 85%, and 95%) for at least 5 hs. Before the last two alcohol steps, the thallus was counterstained with Fast-green stain for 1 min. After the last alcohol step the tissue was soaked with xylene for 15 mins and infiltrated with a Merck™ soft paraffin wax (melting point of 46-48°C). The infiltration lasted for 1 h in a 60°C hot air oven with infiltration solution diluted to 50% solutions with 95% ethanol. The material was then transferred to an embedding solution (Hard-ajax pastillated paraffin wax with a melting point of 56-58°C) on a cube forming mould. After polymerization, the blocks were pulled out of the mould and mounted on Histoblocs. Sections 5 µm thick were made on a Leica™ rotary microtome, using good quality disposable knives (Superlab knives, Adamas Instruments™). The sections were floated on droplets of distilled water and Mayer's egg albumin fixative on slides and allowed to dry on a hot plate (60°C) for 2 hs, which were then embedded in Eukitt™ to make permanent slides. Then the specimens were photographed for proper documentation using Olympus C-35AD-A™ camera with Konica color VX super 100™ film.

RESULTS AND DISCUSSIONS

This study accounted for eight species of *Padina* from the Visayas and Mindanao regions of southern Philippines. Out of these, three species are new records for the Philippines, namely: *P. fernandeziana* Skottsberg and Levring, *P. jonesii* Tsuda and *P. moffittiana* Abbott and Huisman. One species *P. antillarum* (Kützinger) Piccone, represents a new nomenclatural record, that is, the species has been recognized under its currently accepted name which is applied to a Philippine species for the first time.

Key to the species

1. Plants distromatic or bistratose throughout-----2
1. Plants composed of 2-3 cell layers while middle and basal portions are composed of 4-6 cell layers
-----*P. antillarum*
2. Stipe with stiff, dark, rust-color brown fibrous hairs --3
2. Stipe without stiff, dark, rust-color brown fibrous hairs
-----5
3. Sporangial sori on both surface of the frond
-----*P. moffittiana*

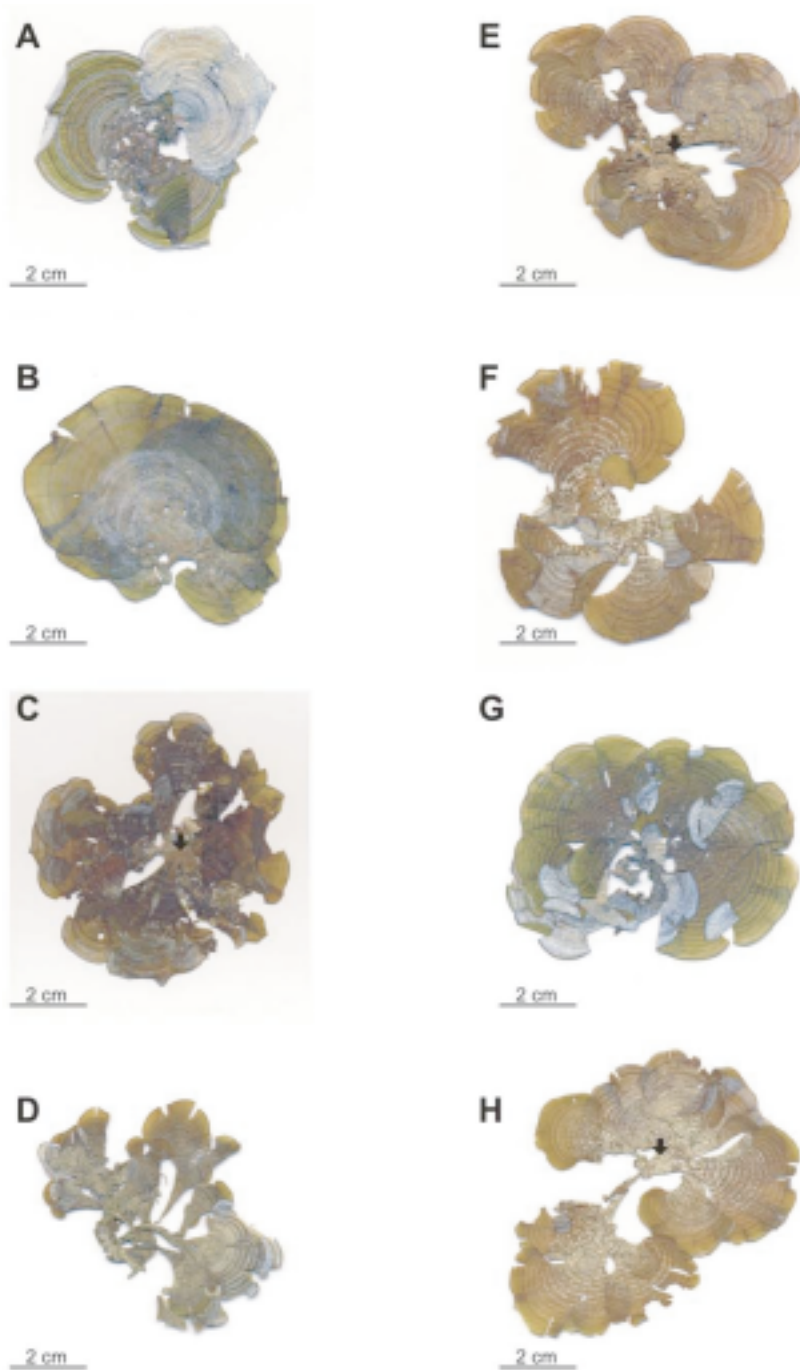


Fig. 1. The different Philippine *Padina* species in macroscopic surface view. A, *P. sanctae-crucis*; B, *P. minor*; C, *P. fernandeziana*; D, *P. antillarum*; E, *P. moffittiana*; F, *P. australis*; G, *P. boryana*; H, *P. jonesii*. Rust-colored fibrous hairs (arrow) on the stipe in figures C, E, H.

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|---|---|
| 3. Sporangial sori only on one surface of the frond -----4 | 6. Sporangia found only on inner surface of the frond ----- <i>P. minor</i> |
| 4. Fertile zones occurring alternately among interpilar spaces ----- <i>P. jonesii</i> | 6. Sporangia found only on outer surface of the frond ---7 |
| 4. Fertile zones occurring successively among interpilar spaces ----- <i>P. fernandeziana</i> | 7. Phaeophycean hairs located on both surfaces ----- <i>P. australis</i> |
| 5. Tetrasporangia covered with indusium ----- <i>P. sanctae-crucis</i> | 7. Phaeophycean hairs located only on outer surface ----- <i>P. boryana</i> |
| 5. Tetrasporangia without indusium-----6 | |

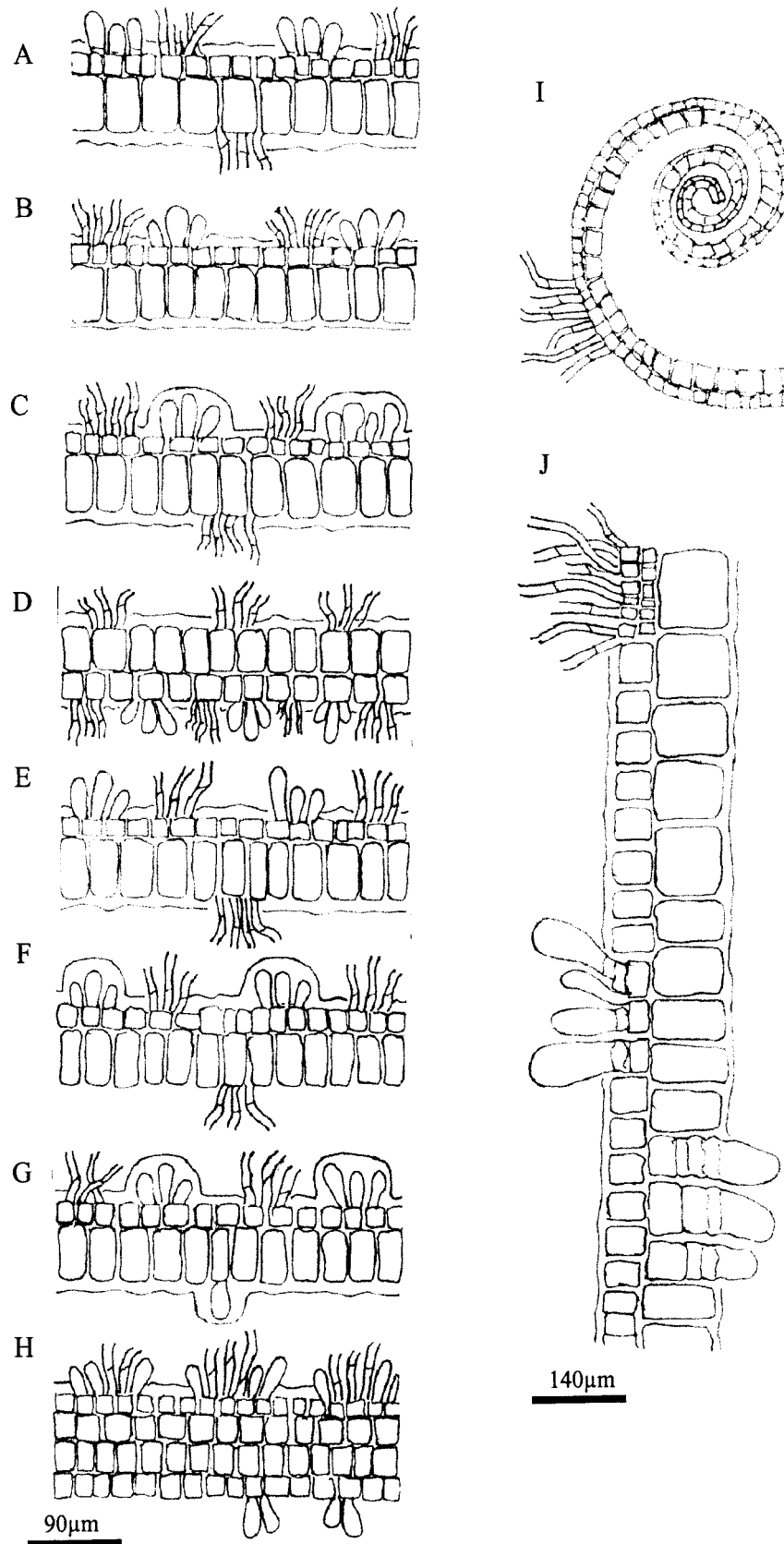


Fig. 2. Sporangial-hair arrangement of the described Philippine *Padina* species. A, *P. australis*; B, *P. boryana*; C, *P. sanctae-crucis*; D, *P. minor*; E, *P. jonesii*; F, *P. fernandeziana*; G, *P. moffittiana*; H, *P. antillarum*; I, Circately in-rolled apical portion of a typical *Padina*; J, Longitudinal section view of a typical *Padina*.

Description of species***Padina antillarum* (Kützinger) Piccone (1886: 36)**

Figs 1-D, 2-H, Table 1

Description: The plant measures (5.9-) 6.58 (-7.3) cm, broadly flabellate with a stupose holdfast, lightly calcified on both surfaces of the thallus especially at stipe. Longitudinal section shows the plant is composed of 3-4 cell layer on the apical to middle portion of the thallus. Apical cell measures (40-) 41.6 (-44) μm in height, (36-) 51.2 (-60) μm in length. Subapical cell measures (28-) 37.6 (-44) μm in height, (52-) 59.2 (-68) μm in length. Smaller and rectangular in shape outer cells measure (48-) 51.2 (-56) μm in height, (52-) 57.6 (-64) μm in length. Larger and rectangular in shape inner cells measure (44-) 50.4 (-56) μm in height, and (52-) 69.6 (-88) μm in length. The cells in between inner and out cells measure (52-) 56.8 (-72) μm in height, and (44-) 96 (-140) μm in length. The stipe has up to 7 cell layer. The plant is zonate with interpilar spaces measuring (1-) 1.8 (-2) mm apart, reproductive zones successive, and to be found on both outer and inner surfaces of the thallus. Tetrasporangia in sori without indusium, in concentric rows, girdling the phaeophycean hairlines, oval to spherical shape measuring (80-) 98.0 (-120) μm in height and (50-) 68.0 (-80) μm in diameter. Phaeophycean hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in deeper sublittoral region (5-10 meters deep), attached on sands or rocks and corals. Sexual plant is unknown.

Type locality: Tortuga, Hispaniola

Specimens examined: *Visayas:* PAP62, Estancia, Iloilo, Jan. 12, 2004, Rojo *et al.*; Bantayan Beach, Dumaguete, Jul. 3, 1991, Layon; CEBU16046, Nueva Valencia, Guimaras, Aug. 29, 2001, Colina; T16818, Burias Is., San Pascual, Masbate, Sep. 5, 1980, Dee; CEBU16084, Guihulngan, Negros Oriental, May 26, 2003, Liao; CEBU16045, San Carlos City, Negros Occidental, Dec. 27, 1990, Apurado; CEBU16130, Guiwanon, Compostela, Cebu, Aug. 17, 2004, Liao & Suzara; CEBU16042, Maribago, Mactan Is., Cebu, Jun 29, 1980, Basnillo; CEBU16086, Buyong Beach, Maribago, Cebu, Jun. 28, 2003, Liao; CEBU16072, Bato, Cordova, Mactan Is., Cebu, Jul. 20, 2002; CEBU16082, Naga, Cebu, May, 12, 1964; CEBU16085, Looc, Argao, Cebu, Sept. 22, 1998, Alcano; CEBU16043, Toledo City, Cebu, Sept. 2, 2001, Dandan; CEBU16044, San Francisco, Camotes, Cebu, Sept. 1, 2001, Tanduyan; CEBU16047, Poo, Tubigon, Bohol, Sept. 7, 1982, Geonzon; *Mindanao:* PAP21, Jasaan, Misamis Oriental, Nov. 9, 2003, Villaluz; PAP78, Maasin, Zamboanga City, Dec. 10, 2003, Macario

et al.; T11701, Big Sta. Cruz Is., Zamboanga City, Zamboanga del Sur, Jan.-Feb. 1941, Bartlett; T11702, Zamboanga City, Zamboanga del Sur, Jan.-Feb. 1941, Bartlett; PAP81, Homi Beach, Basilan, Jan. 25, 2004, Macario *et al.*; T11704, Toburan, Basilan, Jan-Feb. 1941, Balhani; T11707, Sumut, Basilan, Jan.-Feb. 1941, Balhani; T 11706, Basilan Is., Basilan, Jan. -Feb. 1941, Balhani; T11705, Lanhil, Little Sibago Is., Basilan, Jan.-Feb. 1941, Balhani; *Palawan:* San Vicente, Palawan, May 19, 1996, Calumpang *et al.*

World-wide distribution: *Caribbean Basin:* Florida, *East Asia:* Hongkong, *South-east Asia:* Singapore, Thailand, Malaysia, Vietnam, Philippines, *East Africa, Indian Subcontinent and Indian Ocean:* India, Sri Lanka, *Australia and New Zealand:* Queensland.

Discussion: *Padina antillarum* is traditionally known as *P. tetrastromatica* Hauck, which was recently designated as a synonym to this species (Wynne and DeClerck 1999). This species has 3-4 cell layers, and the most distinguishing characteristic of this species are tetrasporangia girdling the hairline. This species is similar to *P. distromatica* Hauck but is different due to the number of cell layers. This species is often confused with the latter since most descriptions do not include longitudinal sections and depend only on ocular description. *Padina antillarum* is distinctly four-cell layered while *P. distromatica* is always two-cell layered.

***Padina moffittiana* Abbott and Huisman (2003: 174-175, figs 1-5)**

Figs 1-E, 2-G, Table 1

Description: The entire plant measures to (7.8-) 8.5 (-9.5) cm in height, broadly flabellate with a stupose holdfast, sufficiently calcified on both surfaces of the thallus, stipe with stiff, dark, rust-color fibrous hairs. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (23.4-) 32.5 (-39) μm in height, (39-) 42.38 (-49.4) μm in length. Subapical cell measures (18.2-) 26 (-31.2) μm in height, (23.4-) 33.28 (-39) μm in length. Larger inner cells measure (39-) 48.88 (-59.8) μm in height, (44.2-) 56.42 (-72.8) μm in length. Smaller outer cells measure (31.2-) 38.48 (-41.6) μm in height, and (44.2-) 57.46 (-78) μm in length. The plant is zonate with interpilar spaces measuring (3-) 3.8 (-5) mm apart, fertile zones alternate, to be found on the outer surface and sometimes also, in clusters, on the inner surface of the thallus. Tetrasporangia in sori with thin indusium, club oval to spherical shape measuring (96.72-) 96.72 (-127.4) μm in

height and (57.2-) 91 (-109.2) μm in diameter. Phaeophyceean hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in deeper sublittoral region (8-20 meters deep), attached on sands or rocks and corals. Sexual plant is unknown.

Type locality: Maro Reef, North-western Hawaiian islands

Specimens examined: *Visayas:* PAP59, Carles, Iloilo, Jan. 13, 2004, Buhayan; PAP61, Batad, Iloilo, Jan. 10, 2004, Gomeri; PAP80, Argao, Cebu, Nov. 10, 2003, Geraldino *et al.*; *Mindanao:* PAP09, Himama-ug, Surigao del Norte, Mar. 31, 2004, Geraldino *et al.*; PAP42, Cortes, Surigao del Sur, Jan. 7, 2004, Geraldino *et al.*

World-wide distribution: *Pacific Islands:* Hawaiian Islands, *South-east Asia:* Philippines.

Discussion: Some 32 species are credited to *Padina* (Wynne 1998), of which 18 species are multistratose (greater than two cells thick, at least at the base) and therefore unlike the bistratose *P. moffittiana*. The remaining 14 species are bistratose throughout. The distinctive characteristic of this species is having tetrasporangia on the inner surface of the thallus (Abbott and Huisman, 2003). This is a deep water species, with rust colored fibrous hairs on the stipe. The type specimen of this species is from Hawaii, which makes it likely for this species to be found in the Philippines since most of the marine floras from Hawaii are also encountered in the Philippines. This species is reported for the first time from Philippine waters.

The presence of *Padina moffittiana* in Philippine waters is not entirely surprising. The absence of any large land mass in the Pacific Ocean, specifically in the area between the Hawaiian Islands and the Philippines, allows long-distance dispersal of marine species to occur. Oceanic currents are responsible for such dispersal. Silva (1992) noted that endemism among Hawaiian seaweeds is relatively low compared to Hawaiian flowering plants. The marine flora of the Philippines and Hawaii share many common elements. Abbott and Huisman (2003) reported *P. sanctae-crucis* Børgesen and *P. boryana* Thivy as new records from Hawaii. These two species are also reported in the present Philippine study. The occurrence of *P. moffittiana*, first described from Hawaii, in the Philippines is therefore not unexpected.

***Padina jonesii* Tsuda (1972: 98, pl. 5, fig. 8)**

Figs 1-H, 2-E, Table 1

Description: The entire plant measures (8.1-) 9.1 (-10)

cm, broadly flabellate with a stupose holdfast, lightly calcified on both surfaces of the thallus, stipe with stiff, dark, rust-color brown fibrous hairs. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (26) 29.64 (-36.4) μm in height, (28.6-) 32.24 (-36.4) μm in length. Subapical cell measures (20.8-) 25.74 (-33.8) μm in height, (23.4-) 31.72 (-36.4) μm in length. Larger and rectangular in shape inner cells measure (31.2-) 35.88 (-41.6) μm in height, (52-) 74.92 (-98.8) μm in length. Smaller and square in shape outer cells measure (23.4-) 26.26 (-31.2) μm in height, (41.6-) 53.82 (-67.6) μm in length. The plant is zonate with interpilar spaces measuring (3-) 3.8 (-5) mm apart, fertile zones alternate and to be found only on the outer surface of the thallus. Tetrasporangia in sori without indusium scattered between interpilar spaces in concentric rows, oval to spherical in shape measuring (52-) 64.74 (-96.2) μm in height and (39-) 51.74 (-75.4) μm in diameter. Phaeophyceean hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in deeper sublittoral region (5-10 meters deep), attached on sands or rocks, and sometimes seen thriving on dead corals and coral heads. Sexual plant is unknown.

Type locality: Double reef, Guam

Specimens examined: *Visayas:* PAP73, Danjungan Island, Cauayan, Negros Occ., Feb. 20, 2004, Lumbab; PAP72, Danjungan Island, Cauayan, Negros Occ., Feb. 21, 2004, Lumbab; PAP17, USC-Marine Station, Maribago, Cebu, Mar. 11, 2004, Geraldino *et al.*; CEBU16120, Looc, Toledo City, Cebu, Jun. 23, 1996, Young & Lumbab; PAP51, Portobello, Camotes, Cebu, Dec. 14, 2003, Geraldino *et al.*; PAP54, Argao, Cebu, Nov. 10, 2003, Geraldino *et al.*; *Mindanao:* PAP79, Fort Pilar, Zamboanga City, Jan. 18, 2004, Macario *et al.*

World-wide distribution: *East Asia:* Japan, China, *South-east Asia:* Philippines, *Pacific Islands:* Guam, Northern Mariana Islands, Micronesia.

Discussion: According to Tseng (1984) one of the distinguishing features of *Padina jonesii* is having a rusted colored fibrous hair on the stipe, which Abbott and Huisman (2003) overlooked. Tsuda (1972), in describing this species for the first time, commented on the prostrate nature of this species. This characteristic was however not observed in this study. The type specimen of this species is from Guam. Considering the close distance of Guam, it is logical to find this species in the Philippines, since most of the marine flora in Guam are also found in the Philippines (Tsuda 1972). This

species is newly recorded from the Philippines.

***Padina fernandeziana* Skottsberg and Levring (Levring 1942: 621, Figs 5A-E, plate 49: fig. 2)**

Figs 1-C, 2-F, Table 1

Description: The entire plant measures (6.9-) 7.56 (-8.1) cm in height, broadly flabellate, sufficiently calcified on both surfaces of the thallus, stipe with stiff, dark, rust-color fibrous hairs. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (23.4-) 27.82 (-31.2) μm in height, (33.3-) 35.68 (-39) μm in length. Subapical cell measures (26-) 23.66 (-18.2) μm in height, (18.2-) 27.3 (-31.2) μm in length. Larger inner cells measure (33.8-) 35.62 (-41.6) μm in height, (39-) 54.86 (-62.4) μm in length. Smaller outer cells measure (26-) 29.64 (-33.8) μm in height, (36.4-) 44.2 (-54.6) μm in length. The plant is zonate with interpilar spaces measuring (3-) 3.2 (-4) mm apart, fertile zones successive and to be found on the outer surface of the thallus. Tetrasporangia in sori with a distinct indusium, in concentric rows, club shape to oval measuring (72.8-) 79.04 (-88.4) μm in height and (49.4-) 52.52 (-57.2) μm in diameter. Phaeophycean hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in deeper sublittoral region (6-12 meters deep), attached on sands or rocks and coral heads. Sexual plant is unknown.

Type locality: Juan Fernandez Islands, Chile

Specimens examined: *Visayas:* PAP19, San Remigio, Cebu, Apr. 12, 2004, Geraldino *et al.*; CEBU16122, Guiwanon, Compostela, Cebu, Aug. 17, 2004, Liao & Suzara; PAP20, Portofino, Maribago, Cebu, Mar. 1, 2004, Geraldino *et al.*; PAP50, Panglao Island, Bohol, Dec. 17, 2003, Geraldino *et al.*; *Mindanao:* PAP68, Muyle, Marihatag, Surigao del Sur, May 11, 2002, Sajot *et al.*

World-wide distribution: *South America:* Chile: Islas Juan Fernández; Masatierra: Bahia del Padre, Sta. Clara, Bahia Cumberland, El Pangal; Masafuera; Islas Desventuradas: San Felix y San Ambrosio, *South-east Asia:* Philippines.

Discussion: *Padina fernandeziana* is a deep-water species as this was first collected from 40 m deep. Likewise in the present materials studied, these specimens were collected from 6-12 m deep. One of the distinguishing characteristic of this species is the presence of rust-color fibrous hairs. This character is shared with *P. moffittiana* and *P. jonesii*. *Padina fernandeziana* can be distinguished from *P. moffittiana* by the presence of sporangia on the outer surface whereas

P. moffittiana has sporangia on both surfaces. *Padina fernandeziana* can be distinguished from *P. jonesii* by the fertile zones occurring successively among interpilar spaces whereas *P. jonesii* has fertile zones occurring alternately among interpilar spaces. This species is reported for the first time from Philippine waters.

The type specimen of this species is from the Juan Fernandez Islands, about 600 km west of continental Chile in South America. The present report is a significant range extension to the western side of the Pacific Ocean, spanning a distance of about 10,000 miles. The Peru Current from the south region of western South America sweeps past the Juan Fernandez Islands and brings propagules to the equator, which in turn may be dispersed farther west by equatorial currents (Silva 1962). Oceanic islands off the coast of South America like the Juan Fernandez Islands exhibit high endemism of marine algae estimated at 32% (Santelices 1980). Notwithstanding this unique feature, many species from Juan Fernandez Islands (Levring 1942) are also found in other tropical localities like the brown algae *Colpomenia sinuosa* (Roth) Derbes and Solier and *Hydroclathrus clathratus* (Bory) Howe. How the propagules of these species are dispersed from the Juan Fernandez Islands to warmer seas may be explained by long dispersal of spores by ocean currents. Santelices (1992) accounted for many widely distributed species occurring in the Juan Fernandez Islands (45% of total species) as having been dispersed across the Pacific most probably via El Niño or Southern Oscillation (ENSO).

***Padina sanctae-crucis* Børgesen (1914: 45-46, figs 27, 28)**

Figs 1-A, 2-C, Table 1

Description: The entire plant measures (5.0-) 5.72 (-6.2) cm, broadly flabellate with a stupose holdfast, membranous fronds, thallus splits into segments, heavily calcified on both surfaces of the thallus especially at stipe, light-brown in color when live and dried specimen appears whitish with dark brown rings. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (26-) 31.98 (-36.4) μm in height, (36.4-) 42.14 (-46.8) μm in length. Subapical cell measures (23.4-) 26.78 (-28.6) μm in height, (28.6-) 35.88 (-49.4) μm in length. Larger and rectangular in shape inner cells measure (36.4-) 42.64 (-52) μm in height, (52-) 75.14 (-109.2) μm in length. Smaller and square in shape outer cells measure (20.8-) 30.06 (-39) μm in height, and (49.4-) 70.72 (-88.4) μm in length. The plant is zonate with

interpilar spaces measuring (2-) 3.4 (-4) mm apart, fertile zones alternate from the upper part on every two rows of hairs of the thallus towards the stipe, and to be found only on the outer surface of the thallus. Tetrasporangia in sori with prominent indusium, in concentric rows, club shape to oval measuring (67.6-) 84.24 (109.2) μm in height and (49.4-) 67.08 (-91) μm in diameter. Phaeophycean hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in upper sublittoral region (1-4 m deep), attached on sands or rocks and corals heads, sometimes seen epiphytic on other macroalgae. Sexual plant is unknown.

Type locality: St. Croix, Virgin Islands

Specimens examined: Visayas: PNH154987, Angol, Boracay Is., Feb. 1985, Magallanes; PNH155051, Patnognon, Antique, May 1985, Magallanes; T11691, Guimaras Is., Iloilo, Jun. 1952, Soriano; DIC0067, Silliman beach, Dumaguete City, Sept. 17, 1989, Laranjo; CEBU16129, Bantayan beach, Dumaguete City, Apr. 14, 1980, Liao; PNH127581, Catbalogan, Western Samar, Oct. 1979, Cordero & Perez; PNH127392, Borongan, Eastern Samar, May 1979, Cordero & Perez; PNH128859, Rawis, Borongan Eastern Samar, Nov. 1977, Castronuevo; PNH127766, Malbug, Masbate, Dec. 1979, Cordero & Perez; PNH127744, Milagros, Masbate, Dec. 1979, Cordero & Perez; T3683, Bato, Leyte, Nov. 14, 1985, Dino; T3684, Bato, Leyte, Apr. 28, 1985, Bascones; CEBU16103, Liloan, Cebu, Jul. 20, 1980, Combate; PAP03, Portofino, Maribago, Cebu, Mar. 01, 2004, Geraldino *et al.*; PAP05, USC-marine station, Maribago, Cebu, Mar. 11, 2004, Geraldino *et al.*; PAP26, Olango Island, Cebu, Dec. 18, 2003, Geraldino *et al.*; PAP24, Argao, Cebu, Nov. 10, 2003, Geraldino *et al.*; CEBU16124, Sibonga, Cebu, Jan. 30, 1998, Liao; DIC0049, Sumilon Is., Oslob, Cebu, Dec. 16, 1979, Calumpong; PAP22, Panglao Island, Bohol, Dec. 20, 2003, Geraldino *et al.*; PAP25, Panglao Island, Bohol, Dec. 19, 2003, Geraldino *et al.*; Balicasag Is., Bohol, May 19, 2000; CEBU16071, Salagdoong, Siquijor, Oct. 2, 1986, Largo; *Mindanao*: Mambajao, Camiguin Is., Aug. 22, 2001, Bollozos; T17106, Camiguin Is., May 10, 1982, Oclarit; PAP02, Himama-ug, Surigao del Norte, Mar. 31, 2004, Geraldino *et al.*; PAP23, Himama-ug, Surigao del Norte, Nov. 30, 2003, Geraldino *et al.*; PAP66, Turtle Island, Surigao del Sur, Apr. 22, 2003, Sajot *et al.*; PAP65, San Agustin, Surigao del Sur, Jun. 23, 2002, Bucoy *et al.*; PNH124700, Dipolog city, Zamboanga del Norte, 1977, Lagutin; T11690, Simunul, Tawi-Tawi, May. 11, 1952.

World-wide distribution: *Caribbean Basin*: Bermuda,

Florida, Belize, Netherlands Antilles, Barbados, Lesser Antilles, Virgin Islands, Puerto Rico, Hispaniola, Jamaica, Cayman Islands, Cuba, Caicos Islands, Bahamas, *South America*: Brazil, *East Asia*: South Korea, *South-east Asia*: Indonesia, Philippines, *Pacific Islands*: Hawaiian Islands, Fiji, *East Africa*, *Indian Subcontinent and Indian Ocean*: Bangladesh, Pakistan, *Australia and New Zealand*: Western Australia, South Australia.

Discussion: Trono and Ganzon-Fortes (1988) states that *Padina sanctae-crucis* is one of the more heavily calcified species of *Padina*. The same observation was made in this study. Among species of *Padina*, this species is widely distributed. This species can be found in the Atlantic and the Mediterranean as well as throughout the Indo-Pacific region. This species therefore extends from tropical to subtemperate waters. According to Taylor (1960: 237), *Dictyerpa jamaicensis* Collins (1901: 251; type locality: Manchioneal, Jamaica) "is a growth stage of a *Padina*, perhaps of various species, but certainly of this one (*P. sanctae-crucis*)". On the basis of this statement, Papenfuss (1977: 272) made the combination *P. jamaicensis* (Collins) Papenfuss. Most specimens of this kind in the Philippines have always been mistakenly referred to as *P. japonica* Yamada. This latter species is now regarded as a synonym to *P. sanctae-crucis* Børgesen by Gaillard (1975) who has shown that *P. japonica* and probably *P. haitiensis* Thivy are not distinct from *P. sanctae-crucis* plants from Western Australian identified as *P. japonica* agree well with this species. The sporangial sori are confined to the lower surface of the thallus, with a slightly distinct indusium, and when the hair lines on both surfaces are viewed, the sporangia are in fertile zones which alternate with sterile zones.

***Padina minor* Yamada (1925: 251-252, fig. 5)**

Figs 1-B, 2-D, Table 1

Description: The entire plant measures (6.4-) 6.76 (-7.2) cm, broadly flabellate, margin entire, with a stupose holdfast, lightly calcified on both surfaces of the thallus especially at stipe. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (23.4-) 28.6 (-36.4) μm in height, (28.6-) 35.62 (-44.2) μm in length. Subapical cell measures (26-) 28.08 (-33.8) μm in height, (28.6-) 34.58 (-39) μm in length. Larger and rectangular in shape inner cells measure (33.8-) 39 (-46.8) μm in height, (54.6-) 73.84 (-109.2) μm in length. Smaller and square in shape outer cells measure (26-) 29.9 (-33.8) μm in height, (39-) 49.14 (-65) μm in length. The plant is zonate with interpilar spaces

measuring 3 mm apart, fertile zones successive and to be found only on the inner surface of the thallus, and having an equidistant hairlines or sterile line is a distinguishing feature of this plant. Tetrasporangia in sori without indusium, in concentric rows, club shape to oval measuring (72.8-) 91 (-137.8) μm in height and (52-) 77.74 (-117) μm in diameter. Phaeophyceyan hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in shallow sublittoral region (2-5 meters deep), attached on sands or rocks and corals, and sometimes seen epiphytic on other macroalgae. Sexual plant is unknown.

Type locality: Garan-bi (Cape O-luan), Taiwan

Specimens examined: Visayas: PAP60, Batad, Iloilo, Jan. 10, 2004, Gomeri; PAP58, Carles, Iloilo, Jan. 13, 2004, Buhayan; PNH127689, Estancia, Iloilo, Nov. 1979, Cordero & Perez; PNH151974, Boracay, Aklan, Feb. 1982, Magallanes; PNH163867, Batbatan Is., Antique, Jul. 1985, Magallanes; PAP56, Danjungan Island, Cauayan, Negros Occ., Feb. 18, 2004, Lumbab; PAP41, Danjungan Island, Negros, Feb. 18, 2004, Galanza; DIC0074, Bantayan beach, Dumaguete City, Aug. 20, 1990, Maro; DIC0066, Siaton, Negros Oriental, Nov. 22, 1981, Calumpong; DIC0076, Siaton, Negros Oriental, Nov. 22, 1981, Calumpong; Amlan, Negros Oriental, Oct. 8, 1989, Estacion *et al.*; Zamboanguita, Negros Oriental, March 10, 1991, Dolar *et al.*; PNH125797, Zamboanguita, Negros Oriental, Jun. 1, 1978, Smithsonian Marine Biological Project; CEBU16056, San Carlos City, Negros Occidental, Dec. 27, 1990, Apurado; CEBU16027, Lawis, Sipaway Island, San Carlos City, Negros Occidental, Sept. 20, 1980, Yu; CEBU16141, Mondragon, Northern Samar, Oct. 3, 2001, Giray; T7919, Sto. Nino, Samar, Oct. 13, 1975, Maranan; PAP36, Borongan, Samar, Jan. 7, 2004, Ciasico; PNH127352, Catbalogan, Western Samar, May 1979, Cordero & Perez; DIC0077, Isabel, Leyte, Mar. 31, 1982, Rasay; PNH97626, Almeria, Biliran, Leyte, May 10, 1967, Cordero; T646, Danajon Reef, Bato, Leyte, Nov. 28, 1985, Bascones; T16663, Cancabato Bay, Leyte, Aug. 10, 1980, Tiopes; PNH156073, Carigara, Leyte, Jul. 1, 1984, Yap; T16975, Dumrog, Eastern Samar, Nov. 4, 1984, Melquiades; T16984, Dumrog, Eastern Samar, Nov. 4, 1984, Briones; CEBU16138, Placer, Masbate, Jan. 3, 1991, Diola; PNH127344, Cawayan, Masbate, May 1979, Cordero & Perez; T18590, Olango Island, Cebu, Jan. 20, 1990, Ohno; PAP12, Portofino, Maribago, Cebu, Mar. 01, 2004, Geraldino *et al.*; CEBU16134, Maribago, Cebu, Aug. 1, 2004, Liao; PAP34, Argao, Cebu, Nov. 10, 2003,

Geraldino *et al.*; CEBU16137, Argao, Cebu, Feb. 9, 1991, Diola; CEBU16119, Daan-Lungsod, Alcoy, Cebu, Jan. 18, 1992, Osorio & Villaluz; CEBU16118, Santander, Cebu, Sept. 13, 2001, Tejada; PAP38, Panjay, Camotes Island, Cebu, Dec. 14, 2003, Geraldino *et al.*; CEBU16025, San Francisco, Camotes, Cebu, Sept. 21, 2001, Tanduyan; CEBU16134, Northern Poblacion, San Francisco, Camotes, Cebu, Aug. 1, 2004, Surbano; CEBU16105, Salagdoong, Siquijor, May 2-3, 1986, Largo; T15445, Bien Unido, Bohol, Feb. 28, 1986, Dino; PNH114460, Solongon, Siquijor, Feb. 1974, Gutierrez; *Mindanao*: T17107, Camiguin Is., May 9, 1982, Oclarit; CEBU16131, El Salvador, Misamis Or., Spet. 8, 2001, Sendaydiego; CEBU16126, Talisayan, Misamis Or., Feb. 27, 2002, Villaluz; T18114, Poblacion, El Salvador, Misamis Or., May 12, 1990, Nacua; T16869, Initao, Misamis Or., Apr. 29, 1982, Salvana; CEBU16136, Laguindingan, Misamis Or., Sept. 8, 2001, Sendaydiego; PAP10, Himama-ug, Surigao del Norte, Mar. 31, 2004, Geraldino *et al.*; PAP40, Himama-ug, Surigao del Norte, Oct. 30, 2003, Geraldino *et al.*; PAP35, Tubay, Surigao del Norte, Oct. 31, 2003, Geraldino *et al.*; PAP70, Diatagon, Surigao del Sur, Sept. 17, 2000, Adobo; PAP67, Diatagon, Surigao del Sur, Sept. 17, 2000, Ligan; T7793, Samal Is., Davao del Norte, Jan. 6, 1977, Buchan-Antalan; PAP39, Matina, Davao City, Nov. 29, 2003, Geraldino *et al.*; T16944, Tumbler, South Cotabato, Mar. 24, 1984, del Norte; PAP76, Cawit, Zamboanga City, Jan. 22, 2004, Macario *et al.*; PAP77, Caragasan beach, Zamboanga City, Dec. 28, 2003, Macario; T16845, Caragasan Beach, Zamboanga City, Zamboanga del Sur, Aug. 31, 1984, Kadil; PAP78, Golf beach, Zamboanga City, Dec. 25, 2003, Macario; CEBU16055, Sta. Clara, Kalamansig, Sultan Kudarat; T4748, Basbas Pt., Siasi, Sulu, Jun. 15, 1971, Trono; CEBU16054, Sta. Maria, Kalamansig, Sultan Kudarat, Dec. 22, 1996, Albano; CEBU16024, Baliwasan, Kalamansig, Sultan Kudarat, Dec. 23, 1996, Albano; T4857, Muso, Siasi, Sulu, Jun. 18, 1971, Trono; CEBU16104, Panglima Sugula, Tawi-tawi, Sept. 1, 2001, Shariff; Palawan: T18256, Tabon Beach, Quezon, *Palawan*, Aug. 26, 1991, Sariego; T11696, Araceli, Palawan, Jun. 5, 1951.

World-wide distribution: *East Asia*: Japan, China, Taiwan, South Korea, *South-east Asia*: Indonesia, Thailand, Papua New Guinea, Philippines, *Pacific Islands*: Fiji, Northern Mariana Islands, Micronesia, Guam, *East Africa, Indian Subcontinent and Indian Ocean*: Thailand, Seychelles.

Discussion: According to Trono and Ganzon-Fortes (1980), *Padina minor* has wider local distribution than *P.*

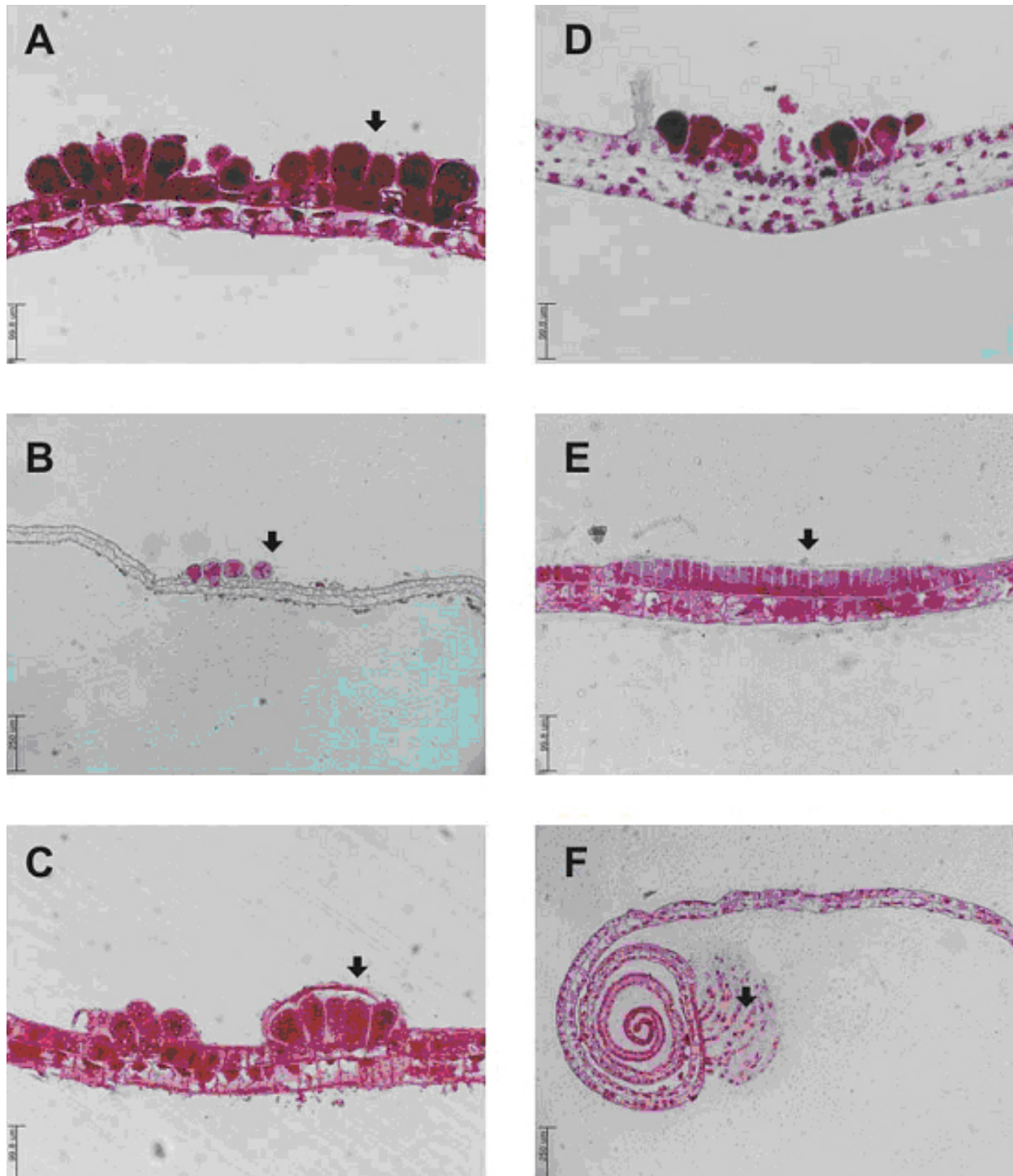


Fig. 3. Anatomical characteristics of *Padina*. A-F, longitudinal section of the thallus; A, distromatic thallus showing non-indusiate tetrasporangia (arrow); B, mitotically dividing tetraspore (arrow); C, distinct indusium covering the sporangia (arrow); D, showing a tetrastrumatic thallus; E, proliferating cells (arrow) on the outer cell layer of the thallus; F, phaeophycecan hairs (arrow) on the apical in-rolled margin of the thallus. Scale bars: B, F = 210 μm ; others = 99.8 μm .

australis. This conclusion was drawn probably due to misidentification of samples. The species name is always mistakenly applied to plants that are small or young and not fertile, despite the fact that it is almost impossible to distinguish species at that juvenile stage. One of the

distinct characteristics of this species is that reproductive structures are to be found only on the inner surface. This characteristic is often overlooked by collectors and hence, specimens have been named erroneously.

Table 1. Comparison of distinguishing features of the Philippine *Padina* species included in this study

Species	Cell layer (thallus)	Location of sporangia	Sori among interpillar zones	Indusia	Position of phaeophyceyan hairs	Rust-colored fibrous hairs	Primary references
<i>P. australis</i>	2	Outer	Alternate	Absent	Alternate surfaces	Absent	Allender and Kraft 1983
<i>P. boryana</i>	2	Outer	Successive	Absent	Outer surface	Absent	Farrant and King 1989
<i>P. fernandeziana</i>	2	Outer	Successive	Present	Alternate surfaces	Present	Levring 1942
<i>P. jonesii</i>	2	Outer	Alternate	Absent	Alternate surfaces	Present	Tsuda 1972
<i>P. minor</i>	2	Inner	Successive	Absent	Alternate surfaces	Absent	Tseng 1984
<i>P. moffittiana</i>	2	Inner & Outer	Alternate	Present	Alternate surfaces	Present	Abbott and Huisman 2003
<i>P. sanctae-crucis</i>	2	Outer	Alternate	Present	Alternate surfaces	Absent	Womersley 1987
<i>P. antillarum</i>	4	Inner & Outer	Successive	Absent	Alternate surfaces	Absent	Wynne and De Clerck 1999

***Padina australis* Hauck (1887 [1886-1887]: 44)**

Figs 1-F, 2-A, Table 1

Description: The entire plant measures (9.6-) 10.46 (-11) cm, broadly flabellate with a stupose holdfast, lightly calcified on both surfaces of the thallus especially at stipe. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (28.6) 31.46 (-33.8) μm in height, (39-) 41.34 (-46.8) μm in length. Subapical cell measures (23.4-) 27.82 (-33.8) μm in height, (28.6-) 37.44 (-44.2) μm in length. Larger and rectangular in shape inner cells measure (39-) 45.76 (-52) μm in height, (46.8-) 74.1 (-117) μm in length. Smaller and square in shape outer cells measure (36.4-) 40.3 (-44.2) μm in height, (41.6-) 59.02 (-78) μm in length. The plant is zonate with interpillar spaces measuring (2-) 3 (-4) mm apart, fertile zones alternate and appear wider mostly from the middle part of the thallus towards the stipe, and to be found only on the outer surface of the thallus. Tetrasporangia in sori without indusium, in concentric rows, club shape to oval measuring (72.8-) 104 (-127.4) μm in height and (57.2-) 73.84 (-93.6) μm in diameter. Phaeophyceyan hairs alternate on both surfaces of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in deeper sublittoral region (5-10 m deep), attached on sands or rocks and corals, and sometimes seen epiphytic on other macroalgae. Sexual plant is unknown.

Type locality: Cape York, Queensland, Australia

Specimens examined: *Visayas*: PAP63, Batad, Iloilo, Jan. 10, 2004, Gomeri; CEBU16061, Nueva Valencia, Guimaras, Aug. 28, 2001, Colina; DIC0070, Piapi beach, Dumaguete City, Aug. 30, 1990, Dolino; DIC0055, Lag-it, Bais Bay, Nov. 22, 1981, Calumpong; Siaton, Negros Oriental, Nov. 22, 1981, Calumpong; CEBU16062, Bacong, Negros Oriental, Feb. 11, 1988, Ascalon; PAP55, San Jose, Negros Oriental, Dec. 28, 2003, Galanza;

CEBU16061, Sipaway Is., San Carlos City, Jul. 5, 1980, Yu; CEBU 16010, Almeria, Biliran Is., Leyte, Jan. 21, 1994, Young; T3655, Bato, Leyte, May 29, 1985, Bascones; Sogod Bay, Southern Leyte, May 16, 1993, Calumpong *et al.*; CEBU16018, Canigao Is., Southern Leyte, Jan. 3, 1985, Aguilar; Buho, Leyte, Jan. 7, 1993, Lucanas; PAP13, USC-marine station, Maribago, Cebu, Mar. 11, 2004, Geraldino *et al.*; PAP11, Portofino, Maribago, Cebu, Mar. 01, 2004, Geraldino *et al.*; PAP45, Olango Island, Cebu, Dec. 18, 2003, Geraldino *et al.*; CEBU16100, Olango Is., Cebu, Oct. 4, 2003, Liao; PAP46, Panglao Island, Bohol, Dec. 19, 2003, Geraldino *et al.*; CEBU16017, Pandanon Is., Bohol, Apr. 9, 1994, Young; *Mindanao*: Naawan, Misamis Oriental, Aug. 22, 1980, Ortega; PAP43, Jasaan, Misamis Oriental, Nov. 9, 2003, Villaluz; PAP54, Catarman, Camiguin, Jan. 10, 2004, Villaluz; PAP48, Himama-ug, Surigao del Norte, Oct. 30, 2003, Geraldino *et al.*; PAP06, Himama-ug, Surigao del Norte, Mar. 31, 2004, Geraldino *et al.*; PAP47, Cortes, Surigao del Sur, Jan. 7, 2004, Geraldino *et al.*; PAP71, Liangga, Surigao del Sur, Sept. 23, 2000, Sinda; T18450, Bongao, Tawi-tawi, May, 16, 1990; CEBU16098, Sta. Maria, Kalamansig, Sultan Kudarat, Dec. 22, 1996, Albano; *Palawan*: T13244, Tubbataha reef, Sulu, Jun. 26, 1981, NRMCMarine Parks Team; T11663, Araceli, Palawan, Jun. 5, 1951, Velasquez; T18239, Quezon, Palawan, Aug. 27, 1991, Sariego; T11651, Cuyo, Palawan, May 12, 1964; Taytay, Palawan, May 1992, Meñez *et al.*

World-wide distribution: *West Africa*: Ivory Coast, Cameroon, Gabon, Angola, *East Asia*: Japan, China, Taiwan, South Korea, *South-east Asia*: Vietnam, Indonesia, Philippines, *Pacific Islands*: Hawaiian Islands, Fiji, *East Africa, Indian Subcontinent and Indian Ocean*: Indonesia, Thailand, Bangladesh, India, Kuwait, *Australia and New Zealand*: Queensland, New Zealand.

Discussion: Trono and Ganzon-Fortes (1988) states

that *Padina australis* is common in tidepools and on reef flats attached to solid substrates by discoid holdfast, and are relatively large. This species thrives mainly in tropical and subtropical waters as no records of this species can be found in temperate waters. Womersley and Bailey (1970) refer to this plant as a rough water species. They often considered it a variety of *P. gymnospora*, best known from the western Atlantic [erroneously cited as eastern Atlantic by Egerod (1974)]. However, it is recognized as distinct by Taylor (1966), Egerod (1974) and others.

***Padina boryana* Thivy in Taylor (1966: 355-356, fig. 2)**

Figs 1-G, 2-B, Table 1

Description: The entire plant measures (4.9-) 5.82 (-6.7) cm, broadly flabellate with a prostrate rhizoid forming holdfast, sufficiently calcified on the inner surfaces of the thallus especially at stipe and lightly calcified on the outer surface of the thallus. Longitudinal section shows the plant is composed of 2 cell layer all throughout. Apical cell measures (31.2-) 34.58 (-39) μm in height, (39-) 49.92 (-67.6) μm in length. Subapical cell measures (26-) 30.16 (-33.8) μm in height, (23.4-) 37.5 (-43.2) μm in length. Larger inner cells measure (26-) 32.24 (-36.4) μm in height, (36.4-) 47.32 (-65) μm in length. Smaller outer cells measure (20.8-) 27.3 (-31.2) μm in height, (31.2-) 47.06 (-54.6) μm in length. The stipe is composed of more than 2 cell layer. The plant is zonate with interpilar spaces measuring (2-) 2.2 (-2.5) mm apart, fertile zones successive and to be found only on the outer surface of the thallus. Tetrasporangia in sori without indusium, in linear concentric rows, club shape to oval measuring (59.8-) 86.84 (-101.4) μm in height and (67.6-) 74.88 (-83.2) μm in diameter. Phaeophycean hairs alternate only on outer surface of the thallus in concentric rows, with outer cortical origin of growth. The plant grows in upper sublittoral region (2-5 m deep), attached on sands or rocks, and sometimes seen thriving on corals heads. Sexual plant is unknown.

Type locality: Tonga

Specimen examined: *Visayas:* PAP74, Danjungan Island, Cauayan, Negros Occidental, Feb. 20, 2004, Lumbab; PAP57, Danjungan Island, Cauayan, Negros Occidental, Feb. 21, 2004, Lumbab; PAP64, Estancia, Iloilo, Jan. 12, 2004, Rojo *et al.*; DIC0073, Bantayan Beach, Dumaguete, Jul. 3, 1982, Calumpong *et al.*; CEBU16107, Dumaguete City, Negros Oriental, Apr. 15, 1980, Liao; Culasian Pt., Negros Oriental, Oct. 23, 1991, Calumpong *et al.*; DIC0071, Zamboanguita, Negros Oriental, June 16,

1979, Calumpong *et al.*; CEBU16121, Mondragon, Northern Samar, Oct. 3, 2001, Giray; CEBU16088, Urdaneta, Lavezares, Northern Samar, Apr. 24, 1998; PAP33, Matarinao Bay, Eastern Samar, Dec. 26, 2003, Ciasico; PAP31, Danao, Cebu, Dec. 1, 2003, Geraldino *et al.*; PAP32, Liloan, Cebu, Oct. 26, 2003, Geraldino *et al.*; CEBU16083, Liloan, Cebu prov., Jul. 21, 1980, Bayron; CEBU16091, Liloan, Cebu, Jan. 12, 1991, Apurado; PAP15, Portofino, Maribago, Cebu, Mar. 01, 2004, Geraldino *et al.*; CEBU16081, Maribago, Mactan Is., Cebu, Jun. 29, 1980, Ybanez; PAP53, Argao, Cebu, Nov. 10, 2003, Geraldino *et al.*; CEBU16117, Badian, Cebu, Aug. 25, 2000, Dacules; CEBU16079, Tubigon, Bohol, Sept. 7, 1982; *Mindanao:* PAP55, Mambajao, Camiguin, Jan. 10, 2004, Villaluz; PAP28, Jasaan, Misamis Oriental, Nov. 9, 2003, Villaluz; CEBU16133, Laguindingan, Misamis Or., Sept. 8, 2001, Sendaydiego; PAP14, Himama-ug, Surigao del Norte, Mar. 31, 2004, Geraldino *et al.*; PAP65, San Agustin, Surigao del Sur, Jun. 23, 2002, Bucoy *et al.*; CEBU16139, Kupiat Is., Davao del Norte, Jan. 2, 1998, Cabonce; CEBU16127, Mati, Davao Or., Jan. 3, 1998, Cabonce; PAP29, Sasa, Davao City, Nov. 29, 2003, Geraldino *et al.*; PAP75, Talon-Talon, Zamboanga City, Macario *et al.*; PAP30, Maasin, Zamboanga City, Oct. 18, 2003, Geraldino *et al.*; PAP52, Tungbangkaw, Tawi-tawi, Nov. 23, 2003, Shariff; PAP27, Simunul, Tawi-tawi, Nov. 20, 2003, Shariff; T11669, Jolo, Sulu, Sept. 16, 1935, Bartlett.

World-wide distribution: *Mediterranean Basin:* Egypt, *West Africa:* São Tomé, *East Asia:* Japan, China, South Korea, *South-east Asia:* Vietnam, Malaysia, Singapore, Philippines, *Pacific Islands:* Hawaiian Islands, Samoan Archipelago, Fiji, French Polynesia, *East Africa, Indian Subcontinent and Indian Ocean:* Christmas Island, Indonesia, Thailand, Andaman Islands, Bangladesh, India, Sri Lanka, Diego Garcia Atoll, Maldives, Pakistan, Iran, Kuwait, Kenya, Tanzania, Mozambique, South Africa, Madagascar, Comoro Islands, Seychelles, Aldabra Islands, Mauritius, Reunion.

Discussion: *Padina boryana* is a truly tropical and subtropical species, as Taylor (1960), noted that there are no records of this species from the colder waters of the western Atlantic, and that this species is a common tropical Indo-Pacific species. Having reproductive structures and phaeophycean hairs only on the outer surface is a distinct characteristic of this species. This characteristic is unique for all distromatic species except *P. melemele* Abbott and Magruder, but the reproductive structures are located on inner surface instead on the

outer surface of the thallus. *P. commersonii* Bory de Saint-Vincent [1828 (1826-1829): 144], a name that traditionally has been applied to the present species, is an illegitimate substitute for *P. tenuis* (C. Agardh) Bory de Saint-Vincent (1827:590), whose basionym, *Zonaria pavonica* var. *tenuis* C. Agardh (1824:264), has been shown by Papenfuss (1977:277) to be referable to *Lobophora variegata* (Lamouroux) Womersley ex Oliveira. The material that Bory de Saint-Vincent had in hand was incorporated in to a new species, *P. boryana*, by Thivy (in Taylor 1966).

ACKNOWLEDGEMENTS

Thank you to our colleagues who have help in the collection of all specimens used in this study. Sincere thanks go to Drs W.J. Lee and I.K. Hwang, Chungnam National University, Deajeon, Korea for helping anatomical techniques. We also thank the following institutions by their respective caretakers for facilitating the examination of herbarium materials in this study: Philippine National Herbarium of National Museum in Manila (Mr. Noe B. Gapas, curator), Gregorio T. Velasquez Phycological Herbarium of the Marine Sciences Institute, University of the Philippines, Diliman, Quezon City (Dr. Edna T. Ganzon-Fortes, curator), Silliman University Marine Laboratory herbarium, Dumaguete City (Dr. Hilconida P. Calumpang, curator), herbarium of the Zamboanga State College of Marine Sciences and Technology in Zamboanga City (Ms. Corazon Alvina, director; Mr. Oliver D. Tito, curator) and the herbarium of the University of San Carlos, Cebu City. This work was supported by a grant from the Marine and Extreme Genome Research Center Program, Ministry of Maritime Affairs & Fisheries of Korea to S.M. Boo and S.J. Kim.

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Received 30 May 2005

Accepted 16 June 2005