INT. J. BIOL. BIOTECH., 3 (2): 215-236, 2006.

STUDIES ON THE GENUS *PADINA* ADANSON 1763

Mohammad Nizamuddin and Mubina Begum

Department of Botany, University of Karachi, Karachi-75270, Pakistan

ABSTRACT

Genus *Padina* Adanson is widely distributed warm tropical waters plant and grows on upper-littoral to sub-littoral zones. A number of species has been described by Phycologists from different parts of the world. The present attempt is made to review the taxonomy and morphology to compile the monographic studies dealing with biodiversity and distribution of the Genus *Padina.* The present study describes the morphology, anatomy and distribution of thirty two species of *Padina*.

Key-words: Genus *Padina*, systematics, monograph, biodiversity, distribution

INTRODUCTION

Genus *Padina* Adanson is widespread throughout the world especially in warmer tropical waters and grows in different habitats ranging from upper-littoral to sub-littoral regions; some species reaches upto 60 meters depth. A number of species has been described and reported from different parts of the world by a number of phycologists among whom Taylor (1928, 1942, 1945, 1960, 1969) is to be highly credited for the contributions to this genus. An annotated taxonomical and morphological review of 33 species follows in the text.

Genus *Padina* was established by Adanson (1763) but Lamouroux (1809) considered it a sub-section of *Dictyota* Lamour. Later in 1816 he used the combination *Padina pavonia* (Linn.) Lamour. C. Agardh (1817, 1820, 1823, 1824) used *Pardina,* a synonym of *Zonaria* C. Ag. based on *Fucus pavonius* Linn. and described a variety, Z. *pavonia.* (Linn.) C. Ag. *β* m*ultifida* C. Ag., from Mediterranean Sea, based on *Zonaria multifida* Draparnard m.s. (specimen communicated by Flugge). Later C. Agardh (1824) described two additional varieties, Z. *pavonia* T *fuscescens* C. Ag., from Ravak Island and *Z. pavonia & tenuis* C. Ag., from Marina Islands [= *Lobophora variegata* (Lamour.) womersley].

During the Voyage Autour du Monde ....."La Coquille" a number of collections were made from tropical waters. These collections initiated Bory to describe new species including new varieties belonging to the genus *Padina*. Bory (1827) described *P. tenuis* Bory, *P. mediterranea* Bory, *P. oceanica* Bory, P. oceanica α *cuneata* Bory, *P. oceanica β composita* Bory, *P. oceanica* T *multifda* (C. Ag.) Bory and *P, durvillaei* Bory. Bory (1827) did not base his species, *P. tennis* on *Zonaria pavonia* & *tenuis* C. Ag. but using the epithet "tenuis" was incidental. This species is the specimen from Illeaux-Tonneliers, near Ile de France, Mauritius islands.

Montagne (1838-1842) also described a new species, P. tenuis Mont., from Cuba using *Z. pavonia* & *tennis* C. Ag., *P. tenuis* Bory, *P. commersonii* Bory and *Z. pavonia* var. *tropica* Martius as synonyms. According to I.C.B.N., *P. tenuis* Bory has priority over *P. tenuis* Mont. It is a clear indication that Montagne also did use the epithet "tenuis" of C. Agardh. Kutzing (July, 1849) and Trevisan (Aug. 1849) also described *Z. tenuis* independently keeping *Z. pavonia* & *tenuis* C. Ag. as synonym. The use of C. Agardh's varietal epithet "tenuis" was incidental in all the cases mentioned above. Mentioning the epithet does not mean that Bory or others based the species on Agardh's specimen. This is in agreement with Womersley and Bailey's (1970) findings.

Agardh (1848, 1882) described all the previously known species of *Padina* viz. *P. pavonia* (Linn.) Lamour, *P. fraseri* (Grev.) J. Ag., *P. durvillaei* Bory and *P. commersonii* Bory (now a supefluous name) and used mutual arrangement of hair-lines and reproductive organs as distinguishing characters of the species of *Padina.* He also discussed upon the existing *Padina* species known at that time i.e. (i) *Zonaria commersonii* Kutz., from Antigua, a young form of *P. commersonii* Bory (ii) *Z.* a*ntillarum* Kutz. from Antilles; *Z. gymnospora* Kutz. (*P. boergesenii* Allender *et* Kraft 1983, 83) from St. Thomas, Virgin Island and *Z. variegata* Kutz. from La Guayra belonged to *P. durvillaei* Bory (iii) *P. pavonia* β *multifida* Martius, from Natal, a sterile form of *P. fraseri* (iv) *Z. pavonia anglica* Kutz., from British coast, *Zonaria pavonia neapolitana* Kutz., from the Gulf of Naples and *Z. tennis* Kutz., from Geneva as synonyms of *P. pavonia* (Linn.) Lamour. (v) *Z. pavonia* & *tenuis* C. Ag., from Marina Island (in L) belonged to *Z. variegata* (Lamour.) C. Ag. [= *Labophora variegata* (Lamour.) Womersley] and (vi) Harvey Ceylon Algae No. 55; Harvey Australian Algae No. 85a and Harvey Friendly Island Algae No. 1, *P. boryana* Thivy belonged to *P. commersonii* Bory (= *p. tenuis* Bory).

Kutsing (1849) described 4 species and a variety viz. *Z. durvillaei* (Bory) Kutz.; *Z. fraseri* Grev.; *Z. pavonia* (Linn.) C. Ag.; *Z. tenuis* Kutz., *Z. tenuis* β *commersonii* (Bory) Kutz. In 1859 he added another 4 species including 2

varieties i.e. *Z. antillarum* Kutz.; *Z. gymnopora* Kutz.; *Z. commersonii* Kutz.; *Z. pavonia anglica* Kutz.; *Z. pavonia neapolitana* Kutz. and *Z. variegata* Kuts (= *P. vickersiae* Hoyt). *Z. antillarum* Kutz. and *Z. tenuis* Kutz do not belong to *Padina* sp. but to *Spatoglossum* Kutz. as both the species possess spores and paraphyses in sori.

Areschoug (1851; 1854) described *Zonaria plumbea A*resch. from South Africa and later known as *Chlanidophora plumbea* (Aresch.) Papenf. but Levring (1940) placed it under *Padina* viz. *P. plumbae* (Aresch.) Levr. Hauck (1887) used Agardh's idea of mutual arrangement of hair-lines and reproductive organs in identification of *Padina* species and proposed three categories:

(i) Reproductive organs on both sides of every other hairlines and in mature condition double zones separated by hair-lines distinctly or indistinctly. ……..... Group - *P. pavonia.*

(ii) Reproductive organs on the upper side of every other hair-lines and in mature condition in the middle of every other hair-lines. ..... Group – *P. cammersonii.*

(iii) Reproductive organs on the upper side of every hairlines and in mature conditions in median bands between hair-lines. ……..... Group – *P. variegata*

Hauck (1887) also considered *Z. fraseri sensu* Kutz. and *Z. gymnospora* Kutz. (Hohenacker Meeresalgen No. 515 = *P. boergesenii* Allender deraft); a synonym of *P. cammersonii* Bory (= *P. tennis* Bory); examination of Kutzing's material of *Z. tenuis* Kutz.; *Z. pavonia anglica* Kutz.; *Z. pavonia neaplitana* Kutz. show that these belonged to *P. pavonia* (Linn.) Lamour. but not to *Z. commersonii* Kutz.

Weber van Bosse (1913) modified the classification of Hauck on the basis of examination of the original specimens in Herb. THURET--BORNET, Herb. KUTZING and in other herbaria. Following characters were used by her;

(i) Reproductive organs on both sides of hair-lines, covered by indusium……..... *P. distromatica*, *P. pavonia*

(ii) Reproductive organs in the middle of every second zone between the two hair-lines a fertile and sterile zones alternating; indusium lacking. ..... *P. australis*; *P. commersonii*; *P. somalensis*

(iii) Reproductive organs distributed in irregular groups on the lower part of the frond; indusium lacking. ..... *P. dubia*

Weber van Bosse also considered *Z. gymnospora* Kutz. belonging to *P. australis* Hauck as both resemble each other in reproductive organs and in distromatic structure but Thivy (1959) maintained their individual identity as *P. gymnospara* Kutz. is dioecious but *P. ausatralis* is monoecious. She also remarked that *Z. gymnospora* Kutz. Exsiccata HOHENACKER No. 515, is the type of *P. commersonii* Bory but Bory based his species on his own specimen (now a superfluous name) and *Z. gymnospora* Kutz. (in herb. Sonder in Mel. 16802) from Cape York, Queensland, paratype of *P.* australis Hauck and *Z. fraseri* sensu Kutz. a variety of or related to *P. commersonii* Bory (= *P. tenuis* Bory).

J. Agardh (1882) considered Z. *gymnospora* Kutz belongs to *P. durvillaei.* Bory but according to Hauck (1887) the former belongs to *P. coinmersonii* Bory. It seems that both of them were handling two different specimens but Weber van Bosse (1913), on examination of the specimens (Exsiccata Hohenacker No. 515) pointed out that these two algae were identical in their features. Hoyt (1920) concluded that Z. *variegata* Kutz. and Z. *variegata* (Lamour.) Hauck belong to *P. vickersiae* Hoyt.

The general concept about P. gymnospora (Kutz) Vickers is the presence of 2-3 layers of cells in thickness, hairlines alternating on the two faces, tetrasporangia median between alternate hair-lines and indusium lacking. But Kutzing's plate 71, fig. II (Tab. Phycol. Vol. 9, 1859) and Vicker's plate VII (1908) agree with the general features of *P. durvillaei* Bory and is in agreement with J. Agardh's findings (1882). Plate 71, fig. 4d of Kutzing and plate VII, p. 7, 9, 10 of Vickers belonged to *P. durvillaei* Bory.

Examination of Kutzings's material in Leiden

Kutzing (1849) made the combination *Zonaria tennis β commersonii* (syn. *Padina commersonii* Bory) based on material from Indian Ocean (in Oceano Indico v.s.) but in 1859 he raised this variety to specific level, *Zonaria commersonii* Kutz. based on the specimen from Antigua. Kutzing's specimen in Leiden (No. 937, 55 ..... 389) is labelled as *Z. commersonii* Kutz. from Adriatic Sea (Mari Adriatiaco) which completely agrees in general features. It is evident that Kutzing made this drawing from the Adriatic material (sterile). On examination this material (apical region) possesses 2 layers of cells, downward 3-layered cells and stipe 6-layered cells. This material possesses growth phase (vaughanilla phase) which is also 6-layered cells. This is in agreement with that of *P. pavonia* (Linn.) Lamour.

On examination sheet No. 937, 55..... 472 labelled as *Z. tenuis* Kutz. (Type locality - Genua) shows structural resemblance to *P. pavonia.*

Sheet No. 937, 55 ..... 437 A labelled as *Z. pavonia neapolitana* Kutz. and No. 937, 55 ..... 437 β as Z. *pavonia anglica* (locality - Torquay Aug. 1844) are considered as synonym of *P. pavonia* (Linn.) Lamour. as there is hardly

any varietal difference. Texture feature is very variable in this species depending on the conditions where the species is growing.

Sheet No. 937, 46 .....126 labelled as *Z. gymnospora* Kutz. from Kupang off Timor (E.M. Weber van Bosse Herbarium) and on the other label, locality written is Mindanao, Ind. Occid. On examination the frond possesses 2-3 layers of cells and sori above each hair-lines which are in conformity with *P. pavonia.*

Sheet No. 937, 34…..... 262 labelled as *Z. gymnospora* Kutz. from Vera Cruz containing 2 specimens (A) frond possesses 6 layers of cells and sori above each hair-lines. (B) Frond possesses 2-3 layers of cells and sori above each hair-lines. These characters are in conformity with *Padina pavonia.*

Sheet No. 937, 34..... 433 labelled as Z. *antillarum Kutz.* from Havana having specimens (A) is fertile and 3-layered cells whereas (B) is large, sterile with 2 layers of +cells throughout. Both are in conformity with the character of *P. tenuis* Bory.

Sheet No. 937, 34..... 432 labelled as *Z. gymnospora* Kutz. from Danish West Indies (Exsiccata Hohenacker No. 554) shows sori arrangement between the hair-line. This cannot be the type of the species as the type locality is St. Thomas, Virgin Island. The type plate 71, fig. II a, shows tetrasporangia in double rows.

***Padina* Adanson 1763: 13**

Syn.: *Zonaria* **Draparnard** in C. Agardh 1817: XX. *Zonaria* Kutzing 1843, 341. *Trattinickia* Weber et Mohr 1804. Fronds erect, tufted, rarely procumbeent or prostrate, stipitate, stupose below; attached by compact felted rhizomatous or rhizoidal holdfast; stipe terete infested by septate rhizoids; upper portion fan-shaped to reniform, thin, entire or splitting into narrow or broad spathulate lobes or segments; curved, involuted, inrolled margin. Flattened parts of the thallus or fan-like frond develops from a transverse row of meristematic cells resulting from repeated longitudinal divisions of an apical cell of ramified complex cylindrico-terete filaments. The increase in thallus width occurs due to further longitudinal division of the meristematic cells. The activity of the meristematic cells leads to the formation of radial cell rows.

Basionym: *Fucus pavonius* Linnaeus 1759, 1345. *Padina pavonia* (Linn.) Lamour. 1816: 304.
Fucus *pavonicus* Linnaeus 1753: 1162; *Padina pavonica* (Linn.) Thivy 1960: 234.

The flat and flabellate portions of fronds grow vegetatively by means of marginal initials which are complex of apical cells of a complex filaments. These filaments develop from stipe which is variously branched and each branch possesses an apical cell. The apical cell persists with its activities and divides longitudinally producing a number of peripheral cells much longer than broad forming initials (meristems) on the curved anterior margins coiling downwards and is followed by horizontal divisions parallel to the surface. Fronds become distromatic, each layer of equal sized cells but gradually differentiating into an upper-small-celled layer and a lower large-celled layer. Further divisions take place forming 2 or more layers of cells. In fronds of 2-layered cells, lower layered cells larger than upper ones but in case of more layered cells, central layered (medulla) cells larger than upper ones. Apical growth is gradually taken over by marginal initials. This phase is composed of many layers of large central cells but gradually decreases to one layer of large central cells as upper portions become compressed or flat. This phase has been termed as growth phase or *Vaughaniella*-stage. Such vegetative growth is common in most of the species studied but not restricted to any particular species as reported by some phycologists.

There has always been confusion and misunderstanding over the type species of the genus *Padina* Adanson, whether the type is Fucus pavonicus Linn. or *F. pavonius* Linn. Some phycologists recognise *F.* pavonicus Linn. The type species others *F. pavonius* Linn. In Species Plantarum vol. 2, pp. 1159 and 1162 (Linnaeus 1753) there are two typographical errors *F.* inflanus Linn. and *F. pavonicus* Linn. respectively. In his later publications, Linnaeus (1755) corrected *F. inflanus* to *F. inflatus* Linn. (**Flora suecica**, p. 431) and *F. pavonicus* to F, pavonius Linn. (**Systema naturae**, 1759, vol. 2, edit. 10, page 1345). *F. pavonicus* and *F. pavonius* are not two names but one and the same name. Exactly similar is the case with *F. inflanus* and *F. inflatus.* This is customary that when species or other taxa are named after their characters, then such characters are mentioned in the text of the taxa but this is not the case with *F. pavonicus*. There it is clearly mentioned as **'gallopavonis'** in the text but in other case Linnaeus used **'inflatis'** in the text of *F. inflanus*. He realised his mistakes and ever since he used *F. inflatus* Linn. and *F. pavonius* Linn. In **Systema naturae**, vol. 2, edit. 12, p. 719, 1767, Linnaeus used *Ulva pavonia* (Linn.) Linn. and not *U. pavonica* (Linn.) Linn. It is very surprising that some phycologists accept *F. pavonicus* Linn. on one hand but on other do not recognise *F. inflanus* Linn. It is avident that *F. pavonicus* Linn. and *F. inflanus*Linn. were typographical errors. The type species of *Padina* Adanson should be *P. pavonia* (Linn.) Lamour. (= Fucus pavonius Linn. not F. pavonicus Linn.).

In external morphology *Padina* species are very similar especially when the specimens are sterile. J. Agardh (1882), Hauck (1887) and Weber van Bosse (1913) considered few characters for the identification of the species

mentioned above. Presently there are 33 known species and are described in the text. The following characters were used for the identification of the species:
(i) Mutual arrangement of sori and hair-lines, (ii) presence or absence of indusium, (iii) number of cell layers in fronds, (iv) presence or absence of sori or hair-lines on both surfaces or only on the upper surface or on the lower surface, (v) habit of the frond and (vi) arrangement of
assimilatory cells i.e. flat or radial.

KEY TO THE SPECIES OF *PADINA*

1. Frond prostate. …… 2
   Frond erect. …… 5
2. Frond 2-layered thick throughout. …… 3
   Frond more than 2-layered thick, throughout. …… 4
3. Sporangial sori indusiate. …… *P. thivyae*
   Sporangial sori non-indusiate. …… *P. jonesii*
4. Hairs on the upper surface of frond. …… *P. maxicana*
   Hairs on the lower surface of frond. …… *P. concrescens*
5. Frond 2-layered thick throughout. …… 6
   Frond more than 2-layered thick. …… 14
6. Sporangial sori non-indusiate. …… 7
   Sporangial sori indusiate. …… 10
7. Sporangial sori on ventral surface of frond. …… 8
   Sporangial sori on dorsal surface of frond. …… 9
8. Hair zones well-developed on upper surface of frond. …… *P. tennis*
   Hair zones on both surfaces of frond. …… *P. minor*
9. Sporangia irregularly scattered. …… *P. australis*
   Sporangia in double rows. …… *P. distromatica*
   Sparangis on every hair-line. …… *P.boryana*
10. Frond non-calcified. …… *P. plumbea*
    Frond calcified. …… 11
11. Hair zones alternate on the opposite surfaces of frond. …… *P. perindusiata*
    Hair zones otherwise. …… 12
12. Sporangia in irregular bands on both surfaces of frond. …… *P. sanctae-crucis*
    Sporangia on upper surface of frond. …… 13
13. Sporangia in the middle or upper part of frond. …… *P. haitiensis*
    Sporangia on upper side of every other hair-line on the upper surface of frond. …… 14
14. In T.S. 2 layers of cells of similar size. …… *P. elegans*
    In T.S. 2 layers of cells of dissimilar size. …… *P. japonica*
15. Frond not splitting into lobes or segments. …… *P. glabra*
    Frond splitting into lobes or segments. …… 16
16. Frond uncalcified. …… 17
    Frond calcified. …… 21
17. Frond vertically banded with cells in rows. …… *P. profunda*
    Frond otherwise. …… 18
18. Sporangial sori indusiate. …… *P. fernandiziana*
    Sporangial sori non-indusiate. …… 19
19. Sporangia in double zones in upper portion but fading below, scattered in lower portion of frond …… *P. dubia*
    Sporangia otherwise. …… 20
20. Frond marginally 2-layered, otherwise 4-layered. …… *P. somaliensis*
    Frond marginally 2-layered, in middle 3-layered; below 4-layered. …… *P. tetrastromatica*
21. Sporangial sori non-indusiate. …… 22
    Sporangial sori indusiate. …… 25
22. Frond greagarious, incrustation on its lower parts. …… *P. durvillae*
    Incrustation on ventral surface. …… *P. commersonii*
    Frond otherwise. …… 23
23. Frond mostly 3-layered thick. …… *P. boergesenii*

Frond more than 3-layered thick. ……..... 24
24. Frond marginally 2-layered, in lower parts 9-12 layered thick. …..... *P. caulescens*
Frond marginally 2-layered thick; in middle 4-layered: in lower parts 6-8 layered. ……..….*P. gymnospors*
25. Frond throughout 3-layered thick. ……..…… *P. tristromatica*
Frond more than 3-layered thick. ……..... 26
26. Frond monoecious. 27
Frond dioecious. ……..... 28
27. Frond marginally 2-layered thick; in lower parts 6-8 layered thick. ……..... *P. vickersiae*
Frond marginally 2-layered thick; below 3-4(-6) layered thick. ..... *P. pavonia*
28. Frond robust, thick, 5-6 layered thick in upper parts, 9-10 or more layered thick in the lower parts. ..... *P. srborescens*
Frond otherwise. ……..…… 29
29. Frond 3-layered thick in upper parts, 6-layered thick below. ..... *P. frazerii*
Frond otherwise. 30
30. Sporangia on both surfaces in consecutive interpillary zones. …..... *P. crispata*
Sporangia in every interpillar zones. ……..... *P. crassa*

***Padina arborescens* Holmes 1896: 251**

Chihara 1970: 24. Okamura 1929: 3. Segawa 1960: 29. Silva *et al.* 1987: 77. Tseng 1983: 196. Yamada 1931: 67.

Frond erect, flat, fan-shaped, flabelliform tufted with coloured rhizoids, thick coriaceous, 7-20 (--30) cm high, 6 cm broad, stipitate, stupose below; 2-2.5 cm high, splitting almost up to the lower portion. Basal portion very thick, robust; composed of 9-11 or more layers of cells (280-380 µm) thick in the lower portion, 5-6 layered thick in the middle portion in the upper portion 2-3 layered (60-100 µm) bounded by a single layer of assimilatory cells; sori in concentric zones, alternating every hair bands on the ventral surface, indusiate; tetrasporangia ovate in round sori, densely, irregularly arranged; oogonia obovate and antheridia oblong; sori indusiate, in concentric zones, alternating with hair-bands on the ventral surface. Dioecious.

Type locality: Enoshima, Kanagawa Prefecture. Japan.

Distribution: Japan: Kyusyu to Hakodate; Japan Sea; Fusan (Chosen). **Korea. China**: Fujian and Guangdong Provinces. **Hong Kong. Philippines:** Luzon Pangasinan. Minzanao. Palawan.

The species grows on rocks and stones between the marks, extending up to 4 fathoms or more. Growing in mid to lower littoral rocks. Tseng (1983) reports reproductive organs on the upper surface.
P. arborescens resembles *P. durvillaei* in general habit but differs in the thickness of the frond and in the arrangement of *sex* organs.

***Padina australis* Hauck 1887: 44**

Allender and Kraft 1983: 85. Islam 1976: 39. Lawson and John 1982: 146. Okamura 1932: 88. Price and John 1979: 329. Silva *et al.* 1987: 77. Taylor 1966: 355. Trono 1986: 253. Tseng 1983: 198. Tsuda and wray 1977: 102. Verheij and Prud'homme van Reine 1993: 428. Weber van Bosse 1913: 179; 1928: 490. Yamada 1925: 251; 1931: 70.

Frond erect, broadly flabellate, 8 cm across, 10-15 cm high, thin, translucent, brown on the upper surface up to middle part but whitish due to slightly incrusted lime, on the lower surface; stupose holdfast with tufted rhizoids; frond 50-115 µm thick near the base, 40-50 µm thick near the upper portion; margin entire, often splitting into many flabellate lobes or segments at the margin, covered with brownish hairs up to the middle part of the frond; hair-lines moderately conspicuous (2-3 mm apart); segments distromatic throughout the frond except the basal portions 3-4 cells, bounded by thin layer of assimilatory rectangular cells above and a layer of slightly larger cells below; basal parts thick-walled with many rhizoids on both surfaces; sori concentric on the middle parts in every other interpilar space such that fertile and sterile zones alternate with each other, fertile zones usually broader than others; tetrasporangia obovate irregularly scattered, non-indusiate, 100-110 x 80-90 µm but larger ones 125 x.115 µm; plant monoecious.

Type locality: Cape York, Queensland (in MEL 16802) Australia.

Distribution: Japan: Ryukyu, Karatsu, Tosa Prov.; Kotosho; Formosa. **China:** Guangdog Prov. **Hong Kong. Taiwan. Philippines:** Luzon I. Quezon Prov., Tayabas; Bataan Prov., Lamao; Pangasinan Prov. Alominos. Ilocos Norte Prov., Burgos, Bonbon. Leyte Prov., Leyte I., Tacloban. Palawan I., Tatay. Balbac I., Mindanao I.: Misamis Occidental Prov., Baliangao. **Australia:** Lord Howe Is. Central N.S.W. Coast northward through Queensland to Arnhemland in Northern Territory. (Allender and Kraft 1983). **Indonesia:** Ambon; Bima Bay; Sumbawa Island; Celebes; Macasar Sperorride Archipelago. **Malaya** Archipelago **Bangla Desh:** St. Martin's Island. **West Indies:** Antigua.

Plant grows on lower littoral rocks. Grows on lower intertidal rocks.

P. australis resembles *P. distromastica* in thickness of the frond but differs in the arrangement and distribution of sporangia.

***Padina boergesenii* Allender and Kraft 1981: 87**

Syn.: *Padina gymnospora* (Kutz.) *sensu* Vickers 1905: 58; 1908: 37. Borgesen 1914: 202; 1930: 1701; 1941: 49; 1948: 47. Chapman 1963: 32. Earle 1969: 165. Islam 1976: 40. Misra 1966: 356. Ramon and Friedmann 1966: 192. Schnetter 1976: 73. Taylor 1960: 237; 1966: 356; 1969: 161. Thivy 1959: 69. Verheij and Prud'homme van Reine 1993; 428.

Frond erect up to 8 cm high, flat, flabellate, lobed by splitting up to 6 cm broad, slightly calcified, arising from a stupose holdfast, 110-130 µm thick, distromatic in the apical region, upper layer of small cells up to 35 µm thick and lower down a layer of large cells to 75 µm thick and gradually downward 3 layers of cells, divided by a horizontal wall; the basal part also composed of 3-layers of cells. Central layer of cells shorter than the surface cells. Cell walls thick near the basal part and numerous rhizoids develop from surface cells. Piliferous zones concentric on both surfaces of frond but mostly on the upper surface; tetrasporangia in concentric zones, median between the hairlines; non-indusiate. Plant dioecious.

Type locality: Danish west Indies (Hohenacker 1862). Algae marinae exsicatae fascicle 11.n0.515). (in MEL 47044).

Distribution: West Indies: St. Thomas. St. Croix: Cane Bay, north side; St. Jan: Cruz Bay. **Jamaica. U.S.A.:** Florida. **Austraia:** Lord Howe Island. **Indonesia:** Barang Lompo. **Bangla Desh.** St. **Martin Is. West Coast of India. Pakistan. Israel.**

P. boergesenii is found growing in the littoral and upper sub-littoral region and also found both in more sheltered and quite exposed places.

This species differs from *Zonaria gymnospara* Kutz. *[Padina gymnospora* (Kutz.) Sonder] in section passing through the tetrasporangia (Borgesen Fig. 155a and Kutzing's plate 71, fig. llc) and in number of layers of cells in the basal part. Three layers in P. *boergesenii* but 9 layers of cells in Kutzing's species (Plate 71, fig. IId). Kutzing's Plate 71, fig. IIb suggests the presence of indusium whereas it is lacking in *P. boergesenii*. *P. boergesenii* resembles *P. australis* in habit but differs in arrangement of cell layers (tristomatic in former and distromatic in latter) and in reproduction (dioecium former, monoecious latter).

***Padina boryana* Thivy *in* Taylor 1966: 355**

Lawson and John 1982: 148. Papenfuss 1977: 276. Silva *et al.* 1987: 77. Tseng 1983: 198.

Frond erect to 10 cm high, thin, papery, stupose below, flat, fan-shaped above; splitting into small segments at the margin, lightly calcified only on the lower surface, composed of 2 layers of cells throughout 60-70 µm thick, in upper parts 85-100 µm thick, at the base 3-layered rectangular cells 100-120 µm thick, zonate; hair zones 1-4 mm broad scattered on the upper surface, rudimentary on the ventral surface, delimiting narrow sterile zones -from broader fertile zones or absent; tetrasporangia linear, non-indusiate sori in every interpillar regularly arranged on the upper side of every hair-line on the upper surface forming a continuous line, 120 µm broad; oogonia in linear indusiate sori , 60-80 µm broad; antheridial sori in 1-2 rows.

Type locality: Tonga Is., Pacific Ocean.

Distribution: Polynesia: Friendly (Tonga) Island. **Philippines:** Luzon I.; Cagayan Prov., Babuyan Islands. Calayan Island. Qluezon Prov. Polillo. Catanduanes Prov., Catanduanes. Panay.: Antique Prov. Semirara Island Pasal Pt. Palawan Prov. Balabac. I. Sulu Prov., Jolo I. **Indonesia:** Bali: Kampoengan, Singaraja. Patas. Amboina. **West Africa:** Gulf of Guinea - Sao Tome is.

According to Lawson and john (1982) sori just above each hair zone and absent below and front 3-layered rarely 2-layered. Sao Tome plant grows in wave-sheltered situations and sublittoral fringe.

***Padina caulescens* Thivy *in* Taylor 1945: 99**

Frond erect to 16 cm high, 14 cm broad., stipitate, stupose below, splitting into flabellate segments above; slightly calcified or uncalcified; margin 2-layered thick to 45 µm thick; lower central portion of the segments 9-12 layered thick, 220-250 µm thick; assimilatory cells 20-25 µm wide, lower and upper assimilatory cells of the same width; piliferous zones 1-2 mm apart; hair-lines of the ventral surface (if present) opposed to those of the upper surface; sori zonate; antheridial sori more or less scattered; Oogonial sori in a single or paired, continuous or in broken bands between the hair-lines; plant dioecious.

Type locality: Portion of syntype. Sta. 971 near Maria Magdalena Is., Mexico (Leg.W.R. Taylor no. 39-669, 9-5-1939) labelled as *P. vickersiae.*

Distribution: Mexico - Nayarit, dredged from 5.5-9.0 meters depth, off I. Maria Magdalena, Las Tres Marias.

P. caulescens resembles *P. gymnospora* Sonder in marginal thickening of the frond but differs in the arrangement and distribution of sporangia

***Padina cammersonii* Bory 1828; 141**

Agardh 1848: 113; 1882: 119. Borgesen 1930: 170; 1941: 49; 1948: 48. Durairatnam 1961: 36. Hauck 1887: 44. Hackett 1979: 86. Heydrich 1894: 288. Misra 1966: 135. Okamura 1932: 89. Reinbold 1901: 195. Setchell 1926: 93. Srinivasan 1973: 22. Weber van Bosse 1913: 1978; 1928: 490. Yamada 1925: 251; 1931: 68.
Syn.: *Zonaria tenuis β commersonii* Kutzing 1849: 565. *Zonaria commersonii* Kutzing 1859: 29, t. 72.
Fronds, erect to 12 cm high or more, lightly calcified on the ventral surface; stipitate; stupose; felted holdfast, thin, membranous, flabellate, splitting into lobes or segments, entire at margin, 5-7 cm broad; composed of 2-3 layers of cells (only the older portions with 3 layers of cells); hair lines conspicuous, interpilar spaces very narrow, every other rows of hair lines more developed than the rest of the rows; tetrasporangia on the upper side of every interpilar zone on the upper surface of the upper portion of the fronds, non-indusiate.

Type locality: In mari Pacifico ad insulas Marinas (Freycinet) ad Insubaus Franciae (Bory).

Distributions Japan: Ryukyu, **Taiwan:** Daibanratsu. Garanbi. **Polynesia.** Tonga Island, Pac Ocean. **Northern Australia**. Marshall Islands, Gilbert Islands. **Tahiti. China sea. Thailand. Malayan Archipelago. Indonesia:** Batjan Is. North of Moluccan Groups. **Ceylon: Mauritius Is. India:** Kursadi Is. Okhamandal Coast. Bombay. Dwarka. **Pakistan:** Karach. Red Sea. **East Africa: Mozambique.**

***Padina concrescens* Thivy in Taylor 1945: 102**

Frond gregarious, 5-10 cm high, concrescent, procumbent, imbricate orbicular-flabellate, estipitate with no defined holdfast, attached by ventral rhizoidal cushions; if assurgent then with more definite holdfast, stipitate, stupose below; upper portions adherent to each other by ventral rhizoidal attachments; apical margin inrolled upward; piliferous zones on the ventral surface; sometimes secondary zones present on the upper surface as well as on the lower ones but opposed to the latter; hair zones 2-3 mm apart; upper portions of the segments upto 6-layered thick and the lower portions 10-20 layered, 400-500 µm thick; central layers slightly larger than others; assimilatory cells 12-25 (-30) µm wide; and up to 120 µm high; sori in consecutive interpilary zones, scattered or fusing in large patches on both surfaces or mainly on the upper ones, indusiate, delicate, deciduous; tetrasporangia 100-120 µm broad.

Type locality: W.R. Taylor no. 34-245, 17-18, 30 Jan. 1934. Portion of syntype. Charles Flreana Id, **Galapags**

Islands.

Distribution: Ecuador, Archipielago de Colon, north of Tagus Cove, I. Santa Maria. I. Isabela. Black Beach Anchorage. Gardner Bay, I. Espanola.

Specimens were found growing on reefs and dredged from about 3.6 m depth (Taylor 1945).

This species resembles *P. durvillaei* in general morphology but differs in its procumbent habit and upwardly inrolling of the margin.

***Padina crassa* Yamada 1931: 67**

Allender and Kraft 1983: 87. Okamura 1932: 87. Segawa 1960: 30. Silva *et al.* 1987: 78. Tseng 1983: 198.

Frond erect 3-12 (-16) cm high, shortly stipitate, stupose below, broadly flabellate above up to 9 cm broad, splitting into many small segments; apical margin of segment involute; composed of 6-8 layered thick near the base, 2-4 layered thick near the upper portion 200-300µm thick, covered with brown hairs at the base; segments flabellate, membranous, margin entire, ventral surface slightly incrusted with lime; interpilar zones rather wide (5-6 mm apart); tetrasporangia indusiate (120 x 90 µm) in every interpilar zones rather irregular, sometimes concentric in the middle part of the interpilar zones; sometimes irregularly distributed between 2 hair-lines, oogonia indusiate 192 x 120 µ

Type locality: Syntype localities. Various all in Japan (vide Silva *et al.* 1987: 78).

Distribution: Japan: Chikuzen Prov. Hizen Prov. Nagato Prov. lyo Prov. Sagami Prov. Mutsu Prov. Izumo Prov. Uzen. Central as well as southern part of Japan. **Korea. China:** East China Sea coast and Huanghai; and **Hong Kong. Philippines:** Luzon, Batanes.

Grows in lower intertidal reefs.

This species slightly resembles *P. pavonia* in habit but greatly differs in number of cell layers and in the arrangement of sori.

***Padina crispata* Thivy in Taylor 1945: 100**

Schnetter and B-Meyer 1982: 64.

Frond erect to 10 cm high, 2-6 cm broad, flabelliform, stipitate, bifacially stupose; splitting into segments or lobes, 1-4 cm wide, calcified on the ventral surface; piliferous layers 1-3 mm apart, opposed or only on the upper surface; 2-layered (30-40 µm) thick above, 4-6 layered (65-130 µm) thick in the middle, increasing to 6-8 layered (130-200 µm) thick in the lower portion; cells of these layers 20-40 µm wide; upper assimilatory cells 25-65 µm long and the lower ones 45-75 µm long but in the lower portion of the segment the length of the cells on both surfaces 25-50 µm; tetrasporangial sori on both surfaces in consecutive interpilary zones and forming one or two rows or scattered, delicate indusium; tetrasporangia 75-100 µm broad; oogonial sori indusiate, linear or round up to 250 µm broad; oogonia 35-50 µm broad.

Type locality: Costa Rica (west side). Golfo Dulce (Leg. W.R. Taylor 39-100, 26-3-1938) as *Padina vickersiae* Hoyt.

Distribution: Mexico: Nayarit, Isla Maria Madre. **Costa Rica:** Golfo Dulce. **Columbia:** Bahia Solao. Playa Zolosa. **Panama:** Bahia Honda.

This species is found growing during the months of March-May in lower tide pools and infrequent on rocks (Taylor 1945).

Schnetter and B-Meyer (1982) reported incrustation on upper surface rather on ventral surface.

B. crispata resembles *P. crassa* in habit but differs in the arrangement and distribution of sporangia.

***Padina* distromatica Hauck 1887: 43**

Silva *et al.* 1987: 78. Taylor 1966: 356.

Frond erect up to 10 cm high, tufted, felted, upper part flabellate, lightly incrusted with lime, splitting into segments; composed of 2 layers of cells throughout; hairlines hardly recognisable 5 tetrasporangia non-indusiate, in double zones, lower ones rudimentary, upper one rather broad, 2-5 mm apart in between hair-lines.

Type locality: Meith. **Somalia** (Leg. Hildebrandt, April 1875).

Distribution: Somalia: Meith. **Philippines:** Luzon I.: Pangasinan Prov. Hundered Ids. Mindoro I.: Puerto Galera. Bohol I.: Bohol Prov. Guindulman.

***Padina dubia* Hauck 1887: 45**

Hoyt 1921: 457.

Frond erect to 10 cm high, uncalcified, hardly incrusted with lime near the upper portion of frond; lower portion felted, upper portion flabelliform, flat, splitting into segments, composed of 3-4 layers in the upper-portion, 6 layers of cells downwards but 6-8 layered near the basal parts; tetrasporangia in groups, non-indusiats, double zones in upper portion, fading in lower parts of the segments lowermost part of the segment possesses scattered or irregular and thickly distributed tetrasporangia, hardly free sporangial zones, antheridial sori mostly in irregular zones, distributed on the upper surface of the segment. Sori irregularly scattered over almost the entire surface but in parts in regular zones just above each piliferous zones. Oogonia unknown.

Type locality: Meith, **Somalia** (Leg. HiIdebrandt, April 1875).

Distribution: East Africa: Somalia.

This species resembles *P. vickersiae* in habit and in number of cell layers but differs in the arrangement of sori and being non-indusiate.

***Padina durvillaei* Bory 1827: 591**

Agardh 1848: 113; 1882: 119. Bory 1828: 147. Dawson 1944: 230. Heydrich 1892: 473; 1894: 287. Howe 1914: 73. Hoyt 1921: 457. Lawson and John 1982: 148. Schnetter and B-Meyer 1982: 65.

Syn.: *Zonaria urvillei* Trevisan 1849: 464.
Zonaria durvillaei (Bory) Kutzing 1849: 464.

Frond erect up to 20 (-40) cm high, 6-20 cm broad, thick, coarse; stipitate, stupose below, flabellate-reniform, splitting into broad lobes or segments, margin laciniate, incrusted with lime on the lower parts, upper parts not incrusted; hair-zones ca 3 mm apart and 1 mm wide, composed of 3-12 layers of cells; sori in concentric zones. Assimilatory cells about one-fourth as long as the central cells; in surface view the assimilatory cells usually almost square, 15-25 µm broad but in C.S. (20-) 25-30 µm high, tetrasporangia indusiate; oogonia and tetrasporangia 120-200 µm high, 70-90 µm in diameter; frond near the base up to 18 layered thick, near the middle up to 10-layered thick, near upper portion 3-6 layered thick; medullary cells 25-50 µm high, 15-25 µm broad and 125 µm long. Plant monoecious.

Type locality: Conception **Chile** (Bory).

Distribution: Chile - Conception. **Gulf of California.** Agua Verde Bay. Tepoca Bay. Gonzaga Bay, Tiburon Island. Turner's Island. Pond Island. Puerto Refugio. Guayamas. San Jose del Cabo. Poindexter, Punta Penasco. Bahia Malaja, Isla de la Mucete, Isla Gorgona. **New Guinea. South Coast of Formosa** (Taiwan). **West coast of Africa: Sierra Leone. Ghana. Togo. Mexico** = Baja California, South Shore of Cerros. Pt. Huges, on Cabo San Lazaro. Is. Reilla Gigedo. Nayarit, I. Maria Magdalena. Las Tres Maria. Guerrero, at Ba. Petatlan, Oaxaca, at Ba. Tangola-Tangola, District of Juquila. **Costa Rica** Puerto Culebra. Golfo Dulce. **Panama** - Bahia Honda. Carribean Sea. **Columbia** - Valle, on I. Gorgona. **Ecuador** – Archipelago de Colon, I. Isabela; Pta. Alvemarle; South Shore of Banks Bay. Black Bight. Tagus Cove. Cartago Bay, I. San Salvador; I.Bartolome; Velero Bay. I. Baltra; I. Santa Cruz; Eden I., Conway Bay. Academy Bay. Wreck Bay, I. San Cristobal I. Santa Fe, Black Beach Anchorage, I. Santa Maria. Guaya, La Libertad. La Playa. Salinas. Pta. Santa Elena, Salinas.

This species is abundant and widely distributed in the lower littoral and upper sublittoral belts throughout the Gulf of California during the months of April to June. This is a perennial alga in the Gulf of California and adaptable to great variations of water temperatures and is also widespread along the whole coast from **Costa Rica** to the Head of the Gulf of California. Fertile material is almost abundant in spring and summer. It has so far been reported from a depth of 22 m. Along the coast of **West Africa** it occurs commonly on sand covered rocks in

sheltered to moderately wave-exposed situation in the lower eulittoral subzone and abundant in tide pools (Lawson and John 1982).

This species differs from all known *Padina* spp. in its gregarious, thick and coarse nature and also in the number of cell layers but resembles *P. vickersiae* in texture. Lawson and John (1982) reported 6-8 layers of cells in thickness throughout, whereas Schnetter and B-Meyer (1982) reported 3-18 layers of cells.

***Padina elegans* Koh *ex* Womersley 1827: 220**

Frond erect flabellate, splitting into lobes or segments up to 8 cm high and up to 10 cm broad; lightly calcified on the upper surface or slightly on the lower-surface; 2 layers of cells of similar size throughout or with upper side cells shorter; 70-100 µm thick near the apices and 100-140 µm thick below. Cells in surface view of upper side 20-30 µim broad, L/B 1.5-3 (-4), on the lower surface 25-35 µm broad, L/B 1-1.5 (-2) piliferous hairs in alternating concentric lines on both sides of the frond, 2-4 mm apart on each side, (12-) 14-24 µm diam. Sporangia in concentric, continuous or in broken, sori on the upper side of the frond above each of the hair lines; indusiate tetrasporangia ovoid and broad based 80-100 (-120) x 50-80 (-100) µm. Sexual plant unknown.

Type locality: Midurup Reef, Cottesloe, W. Aust. (Leg. Koh. 17.3.1969 UWA. A-962).

Distribution: West Australia: Port Denison. Rottnest Is. **South Australia:** Eucla. Pearson.

P. elegans resembles *P. sanctae-crucis* in form and in thickness of the frond but differs in cells of similar height remaining 2 cells thick and sporangial sori are on the upper side only with prominent indusium than in *P. sanctae-crucis* (Womersley 1987).

***Padina fernandeziana* Skottsberg et Levring in Skottsberg 1941: 620**

Gaillard 1975: 509.

Frond erect to 20 cm high, uncalcified, flabellate-reniform, splitting into segments; upper part composed of 2-layered cells, rarely 3(-4) throughout; lower assimilatory cells relatively radially elongated infrequently some cells divide but in the lower portions of the segments assimilatory cells (upper and lower) radially elongated. Sori concentric, indusiate, separated by hair-lines; every other hair-lines more or less indistinct so appearing as double zones of sori; sometimes hair-lines alternate on the upper and the ventral surface of segment; tetrasporangia indusiate, concentric, 90-120 x 60-75 µm.

Type locality: Ile Juan Fernandez, near the coast of Chile (Leg. Levring)

Distribution: Chile - Juan Fernandez. San Ambroisio and San Felix.

This species grows in lower littoral region extending to 40 m depth

The species resembles *P. australis*, *P. distromatica.* and *P. Japonica* in habit and in number of cell layers but differs in the arrangement of sori, hair-lines and being indusiate.

Padina fernandeziana resembles, *P. plumbea* in many respects but differs in anatomical structure, 2-(3-4) layers of cells, in the arrangement of radially elongated cells in lower portions and also in habit. Sori appear in double rows because of indistinct hair-lines but according to Gaillard (1975) hair-lines distinct. Geographically the occurrence of the two species is apart that their retention as two separate species is more practical.

***Padina fraseri* (Greville) Greville 1830: XL**

J. Agardh 1848: 114. 1882: 120. De Toni 1895: 246. Endlicher 1843: 535. Gaillard 1975: 509. Lindauer *et al.* 1961: 195. Lucas 1936: 88. Silva *et al.* 1987: 77. Sonder 1846: 156; 1880: 7. Taylor 1966: 356. Womersley 1966: 41; 1967: 222.

Syn.: *Zonaria fraseri* Greville 1829: 423. Trevisan 1849: 464. Kutzing 1849: 565; 1859: 30, P1 . 73, f. I. *Padina commersonii* var. *fraseri* Weber van Bosse 1928: 490.

Frond erect to 10 cm high, 5-13 cm broad, stipitate, stupose below, flabellate-reniform, membranaceous to subcoriaceous, *ca.* 130 µm thick, very dark below, much-paler towards the tips, upper margin inrolled; irregularly splitting into segments; ventral surface lightly calcified; both surfaces with concentric zones of hairs; upper portions composed of 3 layers of cells; basally 6 layers of cells tetrasporangia concentric, indusiate, between the hair lines;

oogonia in 1-2 concentric bands between hair-zones on both surfaces but mostly on the ventral surface.

Type locality: New Holland (Fraser) - Probably Fremantle, W.A. (Womersley 1967).

Distribution: Australia: New Castle, N.S. Wales; Port Phillip Heads, Victoria; North Coast of Tasmania. Lord Howe Island. Norfolk Island. **New Zealand:** Kermadec Island. Ravak Island. **Philippines:** Luzon Is: Cagayan Prov. La Union Point. Ilocos Sur.

This species resembles the known species of *Padina* in habit but mostly differs in the arrangement of sori and assimilatory cells.

There are few specimens of *P. fraseri* in British Museum (Nat. Hist.) mostly from Port Philips Head, Victoria in which only two specimens are from Norfolk Islands. All of these specimens possess 3 layers of cells as in the type specimen. Weber van Bosse (1928) studied the British Museum specimens not the type which is in Edinburgh. Lindauer *et al.'s* (1961) description differ from the type description in possessing up to 6 layers of cells and the photograph reproduced by them also differ from the type in shape and size. A specimen from Harvey's collection from Port Phillips Head is in Thuret-Bornet Herbarium, Museum d`Histoire Naturelle de Paris is not divided into segments and is sterile but possesses 3 layers of cells.

***Padina glabra* Gaillard 1966: 222**

Frond erect, flabellate, 1-1.5 cm, not splitting into lobes or segments, margin entire, slightly calcified, stipitate with felted rhizoidal holdfast; apical margin involute; composed of 2 layers of cells, downwards 3-4 layered (80-120 µm) thick; assimilatory cells 20 x 30 µm and medullary cells 40 x 80 (-100) µm; hair-lines lacking; tetrasporangia non-indusiate, concentric, 60-80 µm broad.

Type locality: Point de Fann, Dakar (Leg. M. Bodard Oct. 1963. no. 266. P. ISO-L).

Distribution: Senegal: Point de Fann, Dakar. **Atlantic Ocean.**

This species resembles *P. vickersiae* in number of cell layers and in disposition of reproductive organs but differs in the absence of indusium, hair-lines and sterile zones.

***Padina* gymnospora (Kutzing) Sonder 1871: 47**

Allender and Kraft 1983: 86. f. 7#, 88. Menez and Calumpong 1981: 382. Schnetter 1976: 73. Silva *et al.* 1987: 78. Taylor 1966: 356. Velasquez *et al.* 1975: 159. Momersley 1966: 356.

Basionym: *Zonaria gymnospora* Kutzing 1859: 29, t. 71. f. II, Martens 1868: 26, 47, 82-88.

Frond erect, 5-15 cm high, 5-20 cm broad, stipitate, stupose below, tufted; splitting into cuneate to flabellate lobes or segments, up to 5 cm broad above, moderately calcified on the upper surface, margin involutes composed of 2 layers of cells (50-60 µm thick) near the growing margin, downward 3-layered (190-110 µm) thick, further downwards 4-layered thick, near the stipe 100-150 µm thick; hair-lines alternate on both surfaces sterile zones (1-4 mm wide) alternating with the fertile zones (1.5-3.0 mm wide); tetrasporangia in discontinuous zones (0.5-1.5 mm wide) usually median between alternate hair-lines, non-indusiate or sliqht on both surfaces but mainly on upper, 90-125 µm in diam.; antheridia in 1-2 bands; oogonia 1 or in groups of 2-4 or more.

Type locality: St. Thomas, Virgin Is., Danish West Indies (in MEL. 583380).

Distribution: Philippines - Luzon I.: Quezon Prov., Tualog. **W. Australia:** Rottnest Is., Cape Naturalist. **Gulf of Mexico – Mexico;** Florida Keys. Texas Isla. Blanca Beach State Park Jetty, South Padre Island near Port Isbel, Cameron County (leg. MT. Wyni 24.3.1975, labelled as *P. vickersiae*). **Malaya - Archipelago. Bangla Desh.** St. Martins Island, **Bay of Bengal. Arabian Sea** - **West Indian Coast** - Tuticorin; Hare Island, Mandapam; Pampan; Bombay; Dwarka. **Coast of Pakistan:** Karachi. **Western Atlantic** - Florida (U.S.A.). Bermuda Is. **Bahamas Is. Brazil. Panama** - Caledonia Harbour, near Isla Piedra and I. San Augustine. **Costa Rica. Columbia. Venezuela. West Indies** - Antilles Trinidad; St. Thomas. St. Croix: Cane Bay; St. Jan: Cruz Bay. Aruba Island. Curacao Island. **Mexico.** Tortugas. Island, Pac. Ocean.

This species grows in the littoral and upper sub littoral regions and also found growing in more sheltered and quite exposed conditions.

P. gymnospora resembles *P. crassa* in number of layers of cells but differs in being non-indusiate rather indusiate tetrasporangia in the latter.

***Padina haitiensis* Thivy in Taylor 1960: 235**

Price and John 1979: 329. Schnetter 1976: 74. Taylor 1969: 161

Frond erect, flat, fan-shaped, 5-8 cm high, 8 cm broad, stipitate, stupose below; holdfast felted; upper portion splitting into lobes or segments reaching up to the stipe; brown below, hardly calcified on the ventral surface, more or less strongly calcified on the upper surface; composed of 2 layers of cells throughout, 65-105 µm thick; zones between hair-lines in the upper surface 1-2 mm wide; zones alternately fertile and sterile; tetrasporangia indusiate in the middle or on the upper part of the fertile zones, 80-110 µm broad.

Type locality: East of Tierra Baja Road, Tortuga Island, Hispaniola (leg. W.L. Schmitt and G.R. Luns no. 17, Sta. 14, 21.3.1937) labelled as *Padina sanctae-crucis* No. 20987 Michigan.

Distribution: Mexico: Tortuga. I. **West Indies: Hispaniolal.** Turks Isla de San Andres - Acuario. Antilles-Antigua.

P. haitiensis resembles *P. sanctae-crucis* in habit but differs in the arrangement of sori.

***Padina japonica* Yamada 1931: 69**

Chihara 1970: 24. Okamura 1932: 87. Segawa 1960: 30. Silva *et al.* 1987: 78. Taylor 1966: 356. Trono 1986: 254. Tsuda and Wray 1977: 102. Velasquez *et al.* 1975: 159.

Frond erect, flat, fan-shaped, 2-8 cm high, flabellate, moderately calcified on the lower surface, stipitate, stupose below; upper portions splitting into segments, entire margin, composed of 2 layers of cells throughout, 90-100 µm thick; frond with a little larger cells on the lower side, cells near the base thick-walled 5 hair-lines conspicuous, interpilar space narrow, 2 mm apart; tetrasporangia indusiate on the upper side of every other hair-line on the upper surface, making a continuous line but sometimes discontinuous 5 rather irregular lines produced along the lower side of the sori, making an incomplete double line.

Type locality: Syntype type localities, various, all in Japan (vide Silva *et al.* 1987: 78).

Distribution: Philippines: Luzon I.: Camarines, Sur Prov., Adiaguao. **Japan:** Satsuma Prov. Higo Prov. Nagato Prov. Iyo Prov. Mikawa Prov. Shima. Echiqo Prov.

Found growing on rocky-corally substrates in mid-littoral areas (Trono 1986).

P. japonica resembles *P. crassa* in habit but differs in number of layers of cells.

***Padina jonesii* Tsuda 1972: 98**

Tseng 1983: 198. Tsuda and Mray 1977: 102.

Frond flat, prostrate up to 16 cm long, heavily calcified on both surfaces, brittle, splitting into lobes or segments adhering to each other or to the substratum by rhizoids arising from the ventral surface; composed of 2 layers of celsl throughout, 75-80 µm thick above, 85-90 µm thick near the basal part; conspicuous, hair zones on the ventral surface, interpillar spaces narrows tetrasporangia non-indusiate in concentric zones above every other hair zone on the ventral surface; 75 µm diam.; fertile and sterile zones equal in width. Oogonia in sori, indusiate usually on the upper side of every other interpillar zone on the upper surface of the frond forming a continuous concentric line.

Type locality: Tsuda 2205. Double Reef, Guam Is. (Leg. Tsuda 11.7.1968, in U.S. Natn. Herb. Smiths. Instn.).

Distribution: Pacific Ocean - Guam Island - Double Reef. Camel Rock, Asan. Apra Harbour. **China:** Guanglong Province.

This species is restricted to the deeper waters (3 to 40 m) over the reef margin and is also perennial. Tseng (1983) reported the occurrence of hairs mostly on upper surface.

P. jonesii resembles *P. thivyae* in habit but differs in prostrate nature and lacking tetrasporangial indusiasm.

***Padina mexicana* Dawson 1944: 231**

Lawson and John 1982: 149.

Frond flat, expanded, resupinate, prostate, broadly flabellate, 1.5-4.0 cm broad, margin entires; stipe not recognizable, attached at the base, and also throughout by numerous rhizoids from the ventral surface; heavily incrusted with lime, zonate; composed of 2-layered cells thick near the revolute margin, but 4-5 (-7) layered cells in older portions; piliferous lines parallel with the margin; hairs only on the upper surface; tetrasporangia indusiate on the upper surface in broken lines or scattered in groups in interpilar zones.

Type locality: D. 725.-Turners Isl. off South end of Tiburon Isl. (Leg. E.Y. Dawson 18-7-1940. Herb. AHF no. 12). Rocky north reef at extreme low tide. Temp. 31°C,

Distribution: Mexico. Gulf of California: Turner's Island Reef, off Tiburon Island. **West Africa: Ghana.**

This species is short-lived summer annual, appears only in warm-water season. It is found growing in rocky pools having 31°C and fairly common in abundance in July (Dawson 1944). Along the west coast of Ghana frond was found growing in moderately wave-exposed situations in the eulittoral zone (Lawson and John 1982).
P. mexicana resembles *P. jonesii* in prostrate habit but differs in number of layers of cells.

***Padina minor* Yamada 1925: 251**

Chihara 1970: 24. Trono 1986: 255. Okamura 1932: 56. Segawa 1960: 30. Silva *et al.* 1987: 78. Tseng 1983: 200. Tsuda 1972: 97. Tsuda and Wray 1977: 102. Verheij and Prud' homme van Reine 1993: 429. Yamada 1931: 68.

Frond small, 5-10 cm high, 1-4 cm broad moderately calcified on both surfaces but more on the upper surface, upper portion flat, fan-shaped splitting into lobes or narrow segments; apical margin involute; composed of 2 layers of cells throughout, 65-70 µm thick in upper portion, at the basal portion 70-75 µm thick; layers of different sizes-upper layer smaller than the lower ones, hair-lines on both surfaces; tetrasporangia non-indusiate or deciduous, in concentric zones or in rows or scattered on every hair-line on the ventral surface; fertile and sterile zones equal in width .

Type locality: Garanbi, **Taiwan** (Formosa).

Distribution: Micronesis: Asanite Bay; Pago Bay and Tumon Bay. Between Catalina Pt. and Anao Pt. **Guam. Indonesia:** Spermonde Archipelago. **Philippines:** Luzon Miandanao. **Taiwan:** - Garanbi to Kii Prov. **China:** Guangdong province.

This species is perennial and grows on rocks and in pools from high tide to low tide in calm places.

Trono (1986) reported concentric hair-lines on the lower surface equidistant from each other.

P. minor resembles *P. japonica* in habit but differs in non-indusiate and arrangement of sori.

The type specimen lacks indusium but Okamura (1932) reported it as deciduous.

***Padina pavonia* (Linnaeus) Lamouroux 1816: 304**

J. Agardh 1848: 113; 1882: 119. Borgesen 1926: 86. Bory 1827: 590; 1828: 145. Durairatnam 1961: 36. Feldmann 1931: 217; 1937: 317. Funk 1927: 365; 1955: 51. Gaillon 1828: 371. Gayral 1958: 230; 1966: 261. Gerloff und Geissler 1971: 752. Giaccone 1968: 223; 1969: 500. Hamel 1939: 343. Hauck 1887: 42. Heydrich 1894: 288. Hoyt 1921: 457. Islam 1976: 40. Lawson and John 1982: 150. Levring 1974: 32. Misra 1966: 154. Montagne 1838-42: 67; 1840:145. Nisamuddin 1981: 25. Nizamuddin and Lehnberg 1970: 122. Ramon and Friedmann 1965: 183. Schiffner 1926: 306. Schnetter and B-Meyer 1982: 66. Silva *et al.* 1987: 78. Srinivasan 1973: 21. Taylor 1960: 234. Tsuda and Wray 1977: 102. Velasquez et *al.* 1975: 159.

Syn.: Fucus *pavonicus* Linnaeus 1753: 1162. *F. pavonius* Linnaeus 1759: 1345. *Zonaria pavonia* C. Agardh 1821: 125; 1823: 225; 1824: 263. Kutzing 1849: 565; 1859: 28, t. 71D. Trevisan 1849: 463. *Zonaria tenuis* Kutzing 1859: 29, t. 71 (excl. fig. d). *Zonaria tenuis β commersonii* Kutzing. 1849: 565. *Zonaria commersonii* Kutzing 1859: 29, t. 72, f. I. *Padina mediterranea* Bory 1827: 590. *Padina oceanica* Bory 1827: 590. *Padina pavonia & anglica* (Kutz.) J. Agardh 1882: 119. *Ulva pavonia* Linnaeus 1767: 719. *Dictyota pavonia* Lamouroux 1809: 39. *Padina pavonia* f. *neapolitana* (Kutz.) J. Agardh 1882: 119.

Frond erect 5-12 (-20) cm high, stipitate, stupose, below; tufted strongly calcified on the upper surface, more lightly on the ventral surface, broadly fan-shaped above, upper portion splitting into lobes to 4 cm or more broad, margin revolute, curved; composed of 2 layers of cells in apical region (65 µm thick), 3-4 layered thick below (100-130 µm thick), near the base 6-layered thick; piliferous zones alternating on both surfaces but often obsolete on the ventral surface; tetrasporangial sori indusiate, more or less in continuous bands or atleast on the upper side of the hair lines of the upper surface (90-140 µm broad), 1.5-4 (-6) mm apart. Antheridial sori alternating with those of the oogonia in bands on each side of the upper surface hair-lines; oogonia 50 µm in diam. Plant monoecious as well as dioecious (Roman and Friedmann 1966).

Type locality: In Mari Europae australis.

Distribution: U.S.A.: Florida. **Bermuda Is. Cuba. Jamaica. virgin Islands.** Barbados. Grenada. **Brazil. Columbia.** Atlantic coast of Europe. Mediterranean Sea. Red Sea. Arabian Sea - **Pakistan. West coast of India. Ceylon. Bangla Desh** - St. Martin's Island, Bay of Bengal. **Malayan Archipelago. Indonesia. Taiwan. Micronesia**

The species generally grows on rocks just below tide in moderately protected situations. This species can also be found growing in deep waters (20 m).

P. pavonia resembles *P. gymnospora* (Kutz.) Sonder in habit but differs in the arrangement of persistent indusiate sori.

***Padina perindusiata* Thivy in Taylor 1960: 235**

Chapman 1963: 183. Earle 1969: 165.

Frond erect to 10 cm high, stipitate, stupose below; flabellate, slightly calcified on both surfaces, upper portion splitting into lobes; zonate; composed of 2 layers of cells throughout, up to 105 µm thick below and up to 90 µm thick in the middle portion; piliferous lines alternating on the opposite faces, zones irregular, alternating fertile (1.5-3.0 mm broad) or sterile (0.75-2.0 mm broad) zones; tetrasporangial sori indusiate, in one continuous or in 2-3 broken lines in the middle of each fertile zone; sporangia 170 µm diam.

Type locality: South West Channel. I. Dry Tortugas, Florida. (Leg. W.R. Taylor, No. 1356. 20-4-1926. Michigan

Distribution: Jamaica: Runaway Bay; Roaring River; Morant Cays.

This is a moderately deep water species dredged from 9-14 m depth (Taylor 1960).

P. perindusiata resembles *P. pavania* in habit but differs in the arrangement of tetrasporangial sori and in number of layers.

***Padina plumbea* (Areschough) Levring 1940: 10**

Gaillard 1975: 505.

Syn.: *Zonaria plumbea* Areschoug 1851: 25; 1854: 362. *Chlanidophora plumbia* (Areschoug) Papenfuss 1940: 204.

Frond erect to 10 cm high, uncalcified, flabellate-palmatifid, lobate, stipitate, stupose belows upper part deeply splitting at the margin reaching almost to the stipe, composed of 2 layers of cells throughout, 130-170 µm thick; assimilatory cells radially elongated, upper layered cells longer than the lower ones, Sporangial sori indusiate, concentric lying between the hair-lines; tetrasporangia 45-55 x 30-35 µm.

Type locality: Port Natal, S. Africa (Leg. Areschong 1847. S).

Distribution: South Africa - Port Natal, Port Edward (Stephenson 1947).

There are variations in the arrangement of cells in *P. plumbea* than other species of *Padina* especially *P. fernandeziana*.

1. In the upper portion of frond the upper assimilatory layers comprise radially elongated cells but the lower-ones having flat cells.

2. In lower portion of frond the upper assimilatory layers are of large, radially elongated cells but the lower layers of frond are of small and radially elongated cells.

3. In L.S. the upper assimilatory cells of frond are flat but the lower ones are of radially elongated cells.

***Padina profunda* Earle 1969: 167**

Frond erect 10-25 cm high, flat, fan-like, margins involute, entire or split, uncalcified, stipitate, stupose below; composed of 2 layers of cells in thickness near the inrolled margins, 3-4 layered (125-500 µm) thick up to the middle, 3-6 layered (500-700 µm) thick at the base; piliferous zones faint; hairs, few, distributed irregularly on both surfaces of the frond; fronds vertically banded with cells in rows (0.25-20.0 mm diam.), larger and strongly pigmented than the adjacent cells. Reproductive organs not observed.

Type locality: Logger Head Key, Dry Tortugas. Florida.

Distribution: Gulf of Mexico: Dry Tortugas, Florida.

This is a deep water alga dredged from 60.0 m depth about 19 miles offshore from Logger Head Key, Dry Tortugas, Florida (Earle 1969).

P. profunda resembles *P. vickersiae* in size and structure but differs in calcification and piliferous zones as well as in vertically banded zones.

***Padina* sanctae-crucis Borgesen 1914: 201**

Chapman 1963: 34. Collins and Hervey 1917: 86. Earle 1969: 171. Gaillard 1975: 85. Howe 1920: 595. Islam 1976: 41. Schnetter 1976: 75. Silva *et al.* 1987: 78. Taylor 1928: 123; 1960: 237; 1969: 161. Verheij and Prud' homme van Reine 1993: 429.

Syn.: *Padina .jamaicensis* (Collins) Papenfuss 1977: 272. Price and John 1979: 329. *Dictyerpa jamaicensis* Collins 1901: 251.

Frond clustered, erect 5-15 cm high, flat, flabellate, substantially calcified only on the upper surface, markedly senate, upper part splitting into lobes or segments; composed of 2 layers of cells in thickness throughout frond; hair-lines alternating with the fertile zones on both surfaces, 1- 2.5 mm apart; sori in bands above each second hair-lines; tetrasporangia in irregular bands, indusiate, up to 120 µm broad. Fronds dioecious; oogonia in 1-2 bands, 0.1-0.25 mm broad; antheridia in a continuous or broken band.

Type locality: St. Croix Virgin Is., West Indies.

Distribution: New Providens. Berry Islands, Gun Cay. Exuma Chains, Crooked Island, Watling's Island. **Mariguana.** Caicos Islands. Great Rugged Island. Orange Cay and Anguilla Isles. **Bermuda Is.** to **Northern South America.** Gulf of Mexico: **Mexico.** Florida Keys to Cape Romano. **Cuba.** Hispaniola. Puerto Rico. Virgin Islands. St. Barthelemy. Guadeloupe. Grenada. **British Honduras. Netherland Antilles.** Isla de Sand Andres, **Columbia. Jamaica** - Portland Point. Negril. Bulls Bay. Doctor's Cave. Montego Bay. Robin's Bay; Darlingford; Morant Point. Morant Cays. Antigua. **West Indies:** St. Croix: Coakley Bay. Southwest Channel, Dry Tortugas Florida. **Bay of Bengal:** St. Martin's Island. Philippines: Luzon. **Indonesia:** Sperononde Archipelago.

This species grows in upper sublittoral zone in exposed place, common on rocks and also reported from 14 m depth (Taylor 1960).

P. sanctae-crucis resembles *P. gymnospora* (Kutz.) Sender in habit but differs in the presence of indusium and distromatic structure.

Taylor (1960) considered *Dictyerpa* Collins a synonym of *Padina* and *D. jamaicensis* Collins a synonym of *P. sanctae-crucis* Borg. Recently Papenfuss (1977) named it *P. jamaicensis* as the epithet *'jamaicensis'* antedates *sanctae-crucis.* Price and John (1979) used the combination *P. jamaicensis* Borg. for *P. sanctae-crucis* Borg. It is certain that Borgesen never used the combination *P. jamaicerisis* Borg. Borgesen should not be aceredited. Papenfuss is the first one to use the combination, *P. jamaicensis* (Collins) Papenf. Borgesen's name is to be retained as there is uncertainty as to which species is represented by the type material of *P. jamaicensis* (Silva *et al.* 1987).

The crux of this confusion is whether *Dictyerpa jamaicensis* Collins is the growth phase only belonging to *P.*

sanctae-crucis or this type of growth phase is found in other species of *Padina* or not. On observation it is evident that such growth phase is not restricted to *P. sanctae-crucis* but also found in *P. tetrastromatica, P. pavonia, P. tenuis* and *P. boergesenii*. This is possible that such growth may be occurring in other species of *Padina. P. sanctae-crucis* Borg. should be retained as it is, and *P. jamaicensis* (Collins) Papenf. and *P. jamaicensis* Borg. *sensu* Price and John. should be rejected.

***Padina somalensis* Hauck 1887: 45**

Frond uncalcified strongly splitting into segments; composed of 2 layers of cells in thickness near the margin otherwise 4 layered thick throughout; rows of hairs and tetrasporangia alternately arranged; tetrasporangia non-indusiate, arranged above the rows of hairs.

Type locality: Scara, **Somalia** (Leg. Hildebrandt, March 1873).

Distribution: Somalia: Scara and Lasgori.

P. somalensis resembles *P. dubia* in the absence of indusium but differs in the arrangement of tetrasporangial sori and in number of layers of cells.

***Padina tenuis* Bory 1827: 590**

Allender and Kraft 1983: 83. Islam 1976: 39. Montagne 1838-42: 67. Nizamuddin 1981: 28. Tsuda and Wray 1977: 102. Tsuda 1972: 98. Verheij and Prud' homme van Reine 1993: 429. Womersley and Bailey 1970: 272.

Syn.: *Zoriaria tenuis* Trevisan 1849: 463 (August).
Padina pavonia f. *tenuis* Schiffner 1916: 195. *Padina boryana* Thivy *in* Taylor 1966: 355. Papenfuss 1977: 276. Tseng 1983: 198. Lawson and John 1982: 148. Silva *et al.* 1987: 77. *Padina* commersonii Bory 1828: 141. J. Agardh 1848: 113; 1882: 119. Borgesen 1930: 170; 1941: 49; 1948: 48. Durairatnam 1961: 36. Hackett 1979: 86. Hauck 1887: 44. Heydrich 1894: 288. Misra 1966: 135. Okamura 1932: 89. Reinbold 1901: 195. Setchell 1926: 93. Srinivasan 1973: 22. Weber van Bosse 1913: 178; 1928: 490. Yamada 1925: 251; 1931: 68.

Frond erect to 14 cm high, lightly calcified on the ventral surface, numerous fan-shaped lobes or segments, 5-7 cm broad, stipitate, stupose below with distinct felted holdfasts composed of 2 layers of cells in thickness throughout frond (rarely 3-layered in the older portions 100- 110 µm thick). 75-100 µm thick at the base, 60-70 µm thick in upper parts. Hair zones well developed on the upper surface (1-4 mm apart), but those on the lower surface rudimentary delimiting narrow sterile zones from broader fertile zones or absents sterile zones broader than the fertile ones; tetrasporangial sori non-indusiate, linear 880-110 µm broad, concentric on ventral surface, very rarely on the upper-surface, above every other hair-line or sometimes scattered towards the base on every hair-line. Oogonial sori linear, indusiate, in rows between hair-lines measuring 60-80 µm broad; antheridial sori in 1-2 rows. Plant monoecious.

Type locality: Mauritius (Leg. Bory).

Distribution: Chile(?)- Micronesia - Asanite Bay, Inarajan; Tummon Bay; Ipan Beach; Asan. **Northern Australia. Japan:** Ryukyu. **China. Taiwan:** Garanbi. Daibanratsu. **Polynesia:** Marshall Island. Gilberts. **Tahiti.** Friendly Island. **Indonesia** - Batjan Island; Spermonde Archipelago. North of Molukken Group; Bali-Kampoengan, Singaraja. Patas, Amboina. **Philippines** - Luzon I.: Cagayan Prov., Babuyan Islands. Calayan Island. Quezon Prov. Polillo. Cantanduanes Prov., Cantanduanes. Panay Island.: Antique Prov., Semirara Islands. Pasal Pt. Palawan Prov. Balabac Island. Sulu Prov., Jolo Island. **Bangla Desh** - St. Martin's Island, **Bay of Bengal. Arabian Sea:** - **Ceylon** - Tonga Island. **Mauritius Islands.** Marina Island. **India:** Okhamandal coast. Bombay. Dwarka. Kursadi Is. **Pakistan** - Karachi. **Red Sea. Mediterranean Sea.**

This species grows on flat reef, between tide marks and generally found growing in warmer season, in subtidal as well as in deeper water.

P. tenuis resembles *P. australis* in habit but differs in having sporangia grouped above every hair line on upper surface lacking on lower surface whereas in the latter sporangia above every hair line but bordered by a lower surface hair line.

***Padina tetrastromatica* Hauck 1887: 43**

Borgesen 1930: 172. Durairatnam 1961: 36. Gaillard 1967: 447. Islam 1976: 41. Lawson and John 1982: 149. Misra 1966: 158. Schnetter 1976: 76. Silva *et al*. 1987: 79. Srinivasan 1969: 26. Taylor 1966: 356. Trono 1986: 255. Tseng 1983: 200. Weber van Bosse 1913: 180; 1928: 490.

Frond erect 10-20 cm high, clustered, uncalcified, flabellate, splitting into lobes or segments, 5-18 cm broad, uncalcified, apical margin entire, involute; donate; composed of 2 layers of cells in thickness near the apical region (30-40 µm thick), 3-layered (80-90 µm) thick in the mid-region becoming 4- layered (130-150 µm) thick in the lower portions or more near the base; narrow rows of hairs in young stage (1-1.5 mm apart), absent or rudimentary in old stage; sporangial sori on both sides of each row of hairs or alternating with each other, non-indusiate, mostly narrow sometimes broadly zoned, upper zone broad and thick, lower-ones punctiform, scattered groups of sporangia. Tetrasporangia 60-80 µm diam., 90-100 µm high. Oogonia obovate 100-120 µm diam. 130-150 µm high. Plant dioecious.

In type description frond near the apex 3-layered, then 4-layered thick throughout frond rarely 6-layered.

Type locality: Meith, Somalia (Leg. Hildebrandt, April 1875 in L) .

Distribution: China: Fujian and Guanglong (Haina Is. and Dongsha Is, Hong Kong. **Philippines** - Luzon I.: Rizal Prov., Pasay. Manila Prov. Malate; Bataan Prov. Cabcaban. **Malayan Archipelago: Singapore.** Flores I. East coast of **India.** Madras. **Ceylon:** Galle. Jaffna. **Bay of Bengal.** Andaman Is. **Arabian Sea** - **West coast of India:** Krusad Is., Pamban; Tuticorin. Cape Camorin. Malabar Hills. Bandra. Kharwar, The Harbour Bengi Bay. Bombay, Colaba. Back Bay. Dwarka. **Pakistan -** Karachi. **Red Sea. East Coast West coast of Africa – Somalia. West Coast West coast of Africa: Gold Coast. Gambia:** Cote d' loire. **Sierra Leon.** Liberia. **Ghana. Togo.**

Found mostly growing in well sheltered as well as in much exposed tidal pools, lagoons and traquil bays. Along the coast of West Africa it grows on Cobbles at a depth of ca. 10 m below low water (Lawson and John 1982).

This species resembles *P. somaliensis* in general habit and in the absence of calcification but differs in arrangement of tetrasporangial sori.

***Padins thivyae* (Thivyi) Doty et Newhouse 1966: 39**

Frond resupinate, prostate, 3 cm long, orbicular, inrolled apical margin, uniformly lightly calcified on both surfaces; rhizoids in dense tufts from the ventral surface so that fronds becoming prostrate on the substratum, imbricated on each other; fronds composed of 2 layers of cells in thickness throughout, 200 µm thick. Fugaceous hairs in concentric zones alternately on both surfaces; sori usually on the upper surface but sometimes may be on either surfaces, in concentric zones, indusiate.

Type locality: No. 13084 in B.P. Bishop Mus. Natatorium at Waikiki. Honolulu (Leg. M.S. Doty, 27-12-1955).

Distribution: Hawaii - Oahu (Waikiki, Honolulu, Beach Park).

This species is commonly found on reef flats from 7-8 of water (Doty and Newhouse 1966).

This species resembles *P. jonesii* in prostrate habit but differs in the presence of indusium and calcification.

***Padina tristromatica* Levring 1942: 60**

Frond erect to 10 cm high, stupose below with thick felted rhizoids, flabellate-reniform 100-130 µm thick composed of 3-layered cells in thickness throughout frond, central cells smaller than other cells; hair-lines more or less inconspicuous, in zones; sori on both surfaces in concentric zones on every seecond hair-line, in mature stage double zoned, indusiate, 90-120 µm long and 50-70 µm broad.

Type locality: San Felix (Leg. Chapin. Templeton. Crocker Exped. 18-2-1935).

Distribution: Desventurado Islands - San Felix. San Ambrosio (Leg. Dr. F. Johow 9-1896).

P. tristromatica resembles *P. fernandeziana* in the arrangement of hair-lines and sori but differs in the number of cell layers.

P. tristromatica and *P. fraseri* are morphologically identical, being dark brown, strongly calcified on both

surfaces but the latter is much more narrowly divided into narrow segments, enrolled margin, with distinct indusiate sori. Both species are tristromatic. In *P. tristromatica* the tetrasporangia are in 2-rows between the hair-lines as the second zone is indistinct but in *P. fraseri* tetrasporangia are numerous between the hair-lines.

***Padina vickersiae* Hoyt ex Howe 1920: 456**

Chapman 1963: 33. Earle 1969: 172. Howe 1920: 359. Islam 1976: 41. Lawson and John 1982: 150. Price and John 1979: 329. Schnetter 1976: 77. Taylor 1942: 56; 1960: 236; 1969: 161.

Syn.: *Zonaria variegata* Kutzing 1859; 30, t. 73, f. 2. *Zonaria variegata* (Lamx.) Martius 1828: Hauck 1887: 91. *Padina variegata* (Kutz.) Vickers 1905: no. 66; 1908: P1. 8. *Padina variegata* (Lamour.) Hauck *sensu* Borgesen 1914: 205.

Frond erect, 10-25 cm high, cuneate-spathulate to fan-shaped, 5-3.7 cm broad, margin entire when young, splitting into lobes or segments, uncalcified or very lightly calcified on the upper surface, zonate; composed of 2 layers of cells thick through most of the frond, 6-8 layered (150-220 µm) thick in the lower portions, hair-lines concentric, 2-7 mm wide usually 4 mm apart; tetrasporangial sori indusiate, scattered irregularly near the middle of the interpilar zones on both surfaces but chiefly on the ventral surface, sporangia 100-120 µm diam.; antheridia and oogonia in broken lines near the middle of each Interpilar zone; oogonial sori indusiate, 30-65 µm diam.; antheridial sori naked, 200 µm diam. Plant dioecious.

Type locality: U.S.A. Fort Macon Jetty, Beaufort, North Carolina (Leg. W.D. Hoyt, 23-8-1907 in U.S. Natn. Herb. Smiths. Instn.).

Distribution: Mexico. U.S.A.: Florida. Texas. North Carolina. **Columbia. venezuella. Bermuda Is. West Indies: Bahamas. Cuba. Jamaica. Hispaniola. Trinidad. Netherland, Antilles. Barbados. Virgin Island. St. Barthelemy. Guadeloupe. Aves Island. Martinique. Brazil. Bangla Desh:** St. Martin's Island. **Bay of Bengal. Somalia.** Lasgori. West coast of **Africa: Gambia:** Cote d' lvoire. **Sierra Leone. Liberia.** Principe Is. Sao Tome Is. **Cameron. Gabon.**

Plant grows on moderately sheltered to moderately wave-exposed rocks in the lower eulittoral subzone (Lawson and John 1982).

P. vickersiae resembles *P. pavonia* and *P. durvillaei* in general habit but differs from them in the arrangement of sori and epidermal cells (assimilatory cells).

ACKNOWLEDGEMENTS

The author is highly indebted to Prof. Dr. J. Gerloff (Late), Botanischer Garten und Botanisches Museum, Berlin-Dahlem for his suggestions and also going through the manuscript. The author is also grateful to the Director, Botanisches Garten und Botanishces Museum for providing facilities during my stay in Berlin. Lastly I thank the Alexander von Humboldt Stiftung for financial help.

REFERENCES

Adanson, M. (1763). *Families des plantes*, 2: [1] + [24] + [4] + 664. Paris.

Agardh, C.A. (1817). *Synopsis algarum scandinaviae*. xi + 135 pp. Lundae.

Agardh, C.A. (1820). *Species algarum, rite cognitae cum synoymis, differentiis specificis et descriptionibus succinctis*, 1(1): i-iv + 1-168, Lundae.

Agardh, C.A. (1821). *Species algarum, rite cognitae cum synonymis, differentiis specificis et descriptionibus succinctis*, 1 (1): i-iv + 1-168, Gryphiswaldiae.

Agardh, C.A. (1823). *Species algarum, rite cognitae cum synonymis differentiis specificis et descriptionibus succinctis*, 1 (l): i-iv + 1-168, Gryphiswaldiae.

Agardh, C.A. (1824). *Systema algarum*.i-xxxviii + 1-312 pp. Lundae.

Agardh, J.G. (1848). *Species, genera et ordines algarum-Fucoidearum*. Vol. 1, 363 pp. Lundae.

Agardh, J.G. (1882). *Till algernes systematik*. Lunds Univ. Arsskr. 1880-1881. 17 (4): 1-134, 3 pls. Lundae.

Allender, B.M. and G.T. Kraft (1983). *The marine algae of Lord Howe Island* (New South Wales): Dictyotales and Cuterilaes (Phaeophyta). Brunonia, 6: 73-130.

Areschoug, J.E. (1851). *Phyceae capensis, quarum particulam quartam, venia ampliss philos*. Fac. Upsal. 1-132 pp.

Upsaliae.
Areschoug, J.E. (1854). Phyceae novae et minus cognitae in maribus extraeuropaeis collectae, quas descriptionibus atque observationibus. *Act. Reg. Soc. Sci. Ups*. Ser. 3, 1: 326-372.
Borgesen, F. (1914). *The marine algae of the Danish West Indies*, Vol. 1, Part 2. Phaeophyceae. [4] + 159-226 + [2] pp. Copenhagen.
Borgesen, F. (1926). *Marine algae -from the Canary Islands*. II-Phaeophyceae. Det. Kgl. Dansk. Vidensk . Selsk. Biol. Meddel. 6 (2): 1-112.
Borgesen, F. (1930). *Some Indian green and brown algae especially from the shores of the Presidency of Bombay*, 9 (2+3): 151-174.
Borgesen, F. (1941). Some marine algae from Mauritius. II-Phaeophyceae. Del. Kgl. Dansk. Vidensk. Selsk. *Biol. Meddel*., 16 (3): 1-81, 8 pls., Kobenhavn.
Borgesen, F. (1948). Some marine algae from Mauritius. Additional lists to the Chlorophyceae and Phaeophyceae. Det. Kgl. Dansk. Vidensk. Selsk. *Biol. Meddel*., 20 (2): 1-55, 1 map, 2 pls. Kobenhavn.
Bory, De Saint-Vincent, M. (1827). Padine – *Padina*. Bot. Crypto. (Hydrophytes). *Dict. Class. Hist. Nat*., 12: 589-591 (Publ. in August).
Bory, De Saint-Vincent, M. (1828). Cryptogamie. In: *Vouage Autour du monde, execute par ordre du roi, sur la Corvette de la majeste*, "La Coquille", pendant les annees 1822, 1823, 1824 et 1825, par M.L.I. DUPERREY. 1-301 pp. Paris (Published in December 1828 not 1829). Cryptogamia was published separately in 6 parts on different dates i.e. 12 Sept. 1927; 26 Dec. 1827; 16 Feb. 1828; Dec. 1828; Aug. 1829; Dec. 1829. Part IV dealing with Dictyotees was published in Dec. 1828 but the Cover of this part dates 1828.
Chapman, V.J. (1963). The marine algae of Jamaica. *Bull. Inst. Jamaica Sci*. Ser., 12, 2: 1-201, Kingston.
Chihara, M. (1970). *Common seaweeds of Japan in colour*. i-xviii + 1-173 pp. Osaka, Japan.
Collins, F.S. (1901). The algae of Jamaica. *Proc. Amer. Acad. Arts and Sci*., 37: 231-270.
Collins, F.S. and A.B. Hervey, (1917). The algae of Bermuda. *Amer. Acad. Arts and Sci. Proc*. 53 (l): 1-95.
Dawson, E.Y. (1944). The marine algae of the Gulf of California. Allan Hancock Pacif. Exped., 3 (10): [4] + 189-452, 77 pls. Los Angeles.
Doty, M.S. and J.Newhouse (1966). Three new species of the Phaeophyta from Hawaii. Occas. Papers Bernice P. BISHOP Mus. 23 (9): 139-146.
Durairatnam, M. (1961). Contribution to the study of the marine algae of Ceylon. Fish. Res. Sta. Dept. Fish., Ceylon, Bull., 10: 1-117, 1-32.
Earle, S.A. (1969). Phaeophyta of the eastern Gulf of Mexico. *Phycol*., 7 (2): 71-254.
Endlicher, S. (1843). Genera plantarum secundum ordines naturals Disposita. *Algae*. Suppl. III. pp. 1-56.
Feldmann, J. (1931). Contribution a la algologique marine de l'Algeries Les algues de Cherchell. Bull. de la Soc. Hist. de l' Afrique de Nord., 22: 179-254.
Feldmann, J. (1937). Algues marines de la Cote des Alberes. *Phaeophycees. Rev. Algol*., 3: 243-335.
Gaillard, J. (1966). Un *Padina* nouveau des Cotes d' Afrique: *Padina glabra. Phycol.*, 5 (4): 222-226.
Gaillard, J. (1967). Etude monographique de *Padina tetrastromatica* Hauck. *Bull. I.F.A.N*. Ser. A. 29 (2): 447-463.
Gaillard, J. (1968). Etude de *Padina fraseri* (Grev.) J. Agardh et comparison avec *Padina tristromatica* levring. *Nov. Hedwigia*, 15: 21-27.
Gaillard, J. (1975). Etude et comparison de *Padina plumbea* (Aresch.) Levring et de *Padina fernandeziana* Skottsb. et Levring. *Nova Hedwigia*, 24 (2/4): 505-513.
Gaillon, B. (1828). Thalassiophytes. *In*: *Dict. Sci. Nat*., 350-406 pp. (Appeared in Mai 1828).
Gayral, P. (1958). *Algues de la Cotes Atlantique Marocaine*, 523 pp., 152 Pls. Rabat.
Gayral, P. (1966). *Les Algues des Cotes Francaise* (Manche et Atlantique). 632 pp. Paris.
Gerloff, J. - Einije Algen aus der Bucht von Daressalaam. *Willdenowia*, 757-776.
Gerloff, J. and U. Gieissler (1971). Eine revidierte Liste der Merresalgen Griechenlands. *Nova Hedwigia*, 22 (3+4): 721-793.
Giaccone, G. (1968). Raccolte di fitobenthos nel Mediterraneo Orientalis. *Gior. Bot. Ital*. 102 (3): 217-228.
Gaiccone, G. (1969). Raccolte di fitobenthos sulla Banchina Continentale Italiana. *Gior. Bot. Ital*. 103: 485-514.
Greville, R.K. (1829) - Descriptiones novarum speciarum ex algarum ordine. *Nov. Act. Physico-Medica*, 14 (2): 421-424, Pl. 26, fig. 2.
Hackett, H.E. (1979). *Marine algae in the atoll environment: Maldive islands*. Thesis, 1969, Duke University, i-xii + [1] + [1]-319 pp. University Microfilms. A XEROR COMPANY, Ann Arbor, Michigan.
Hamel, G. (1931-39). *Phaeophycees de France*. ii-xlvi + 1-432 pp. 10 Pls. Paris.
Hauck, F. (1885)."Die Merresalgen". *In*: *Robenhorst`s Kryptogamen Flora von Deutschland, Osterreich und der Schweiz*. 2: i-xxiii + 575 pp. 5 taf. Leipzig.

Hauck, F. (1887). Ueber einige von J.M. HiIderbrandt in Rothen Meere und Indischen Ocean gesamelte Algen. *Hedwigia*, 26 (2): 41-45.

Heydrich, F. (1892). Beitrage zur Kenntniss der Algenflora von Kaiser-Wilhelms-Land (Deutsch Neau Guinea). *Ber. Deutsch. Bot. Gesell*. 10: 458-485.

Heydrich, F. (1894). Beitrage zur Kenntniss der Algenflora von Ost-Asien, besonders der Insel Formosa, der Molukken und Liu-Kiu Inseln. *Hedwigia*, 33 (5): 267-304; 33 (6): 305-306. pls. XIV, XV.

Holmes, E.M. (1896). New marine algae from Japan. *J. Linn. Soc. Bot*., 31 (214-215): 248-260, Pls. 7-12 (1895-96).

Howe, M.A. (1914). The marine algae of Peru. *Mem. Torrey Bot. Club*, 15: 1-185.

Howe, M.A. (1920). "Algae". *In*: *The Bahama flora*. (N.L. Britton and C.F. Millspough eds), 553-631 pp. New York.

Hoyt, W.D. (1921). Marine algae of Beufort, N.C. and adjacent regions. *Bull. U.S. Bur. Fish*., 1917-1918, 36: 367-556, 3 maps, pls. 84-100.

Islam, A.K.M. (1976). Contribution to the study of the marine algae of Bangladesh. *Bibl. Phycol*., 19: 1-253 (Herausgeb. J. Cramer).

Joly, A.B. (1965). Flora marinha do littoral norte do estado do Sao Paulo e regoes circumvinzinhas., *Boll. No*. 294, Fac. Fil. Cienc. e letras da U.S.P. Bot. 21: 1-393, 2 maps, 59 Pls. Sao Paulo.

Kutzing, F.T. (1843). *Phycologia generalis*, i-xxxii + 1-458 pp., 79 tab. Leipzig (14-16 Sept. 1843).

Kutzing, F.T. (1849). *Species algarum*. i-vi + 1-922 pp. Lipsiae (23-2 4 Ju1y 1849).

Kutzing, F.T. (1859). *Tabulae phycologicae*. 9: i-viii + 1-42, 1-100 tab. Lipsiae (1 Jan. - 9 March 1859).

Lamouroux, J.V.F. (1809). Exposition des characteres du genre *Dictyota* et tableau des especes qu`il renferme. *J. Bot*., 2: 38-44.

Lamouroux, J.V.F. (1816). Histoire des polypiers coralligenes flexibles, vulgaivement nommees zoophytes. i-lxxxiv + [1] + 1-599 + [1] pp. 19 Pls. A Caen.

Lawson, G.W. and D.M. John (1982). The marine algae and coastal environment of tropical West Africa. Beih. Nova Hedwigia, 70: 1-455. J. Cramer Vaduz.

Levring, T. (1940). Die Phaeophyceengattungen *Chlanidophora*, *Distromium* und *Syringoderma*. Kungl. Fysiogr. Salsk. Lund Forhandl. 10 (20): 1-11, (16 Dec. 1940).

Levring, T. (1941). Die Meeresalgen der Juan Fernandez Inseln. *In*: *The natural history of Juan Fernandez and Easter Island* (Skottsber, C ed). 2: 601-670, 49-53 Pls. Uppsala.

Levring, T. (1942). Einige Meeresalgen von den Insein San Ambrosio und San Felix. *Bot. Notiser*, 60-62.

Levring, T. (1974). The marine algae of the Madeira. *Boll. Mus. Munici. Funchal*, 28 (25): 5-111.

Lindauer, V.W., V.J. Chapman, and M. Aiken (1961). The marine algae of New Zewland-II. Phaeophyceae. *Nova Hedwigia*, 3 (2): 129-350.

Linnaeus, C. (1753). *Species plantarum*, 2: 561-1200, Holmiae.

Linnaeus, C. (1755). *Flora suecica*. i-xxxii + 1-464 + [30] pp. Stockholm.

Linnaeus, C. (1759). *Systema naturae*. Edition 10, 2: 1-2384, Holmiae.

Linnaeus, C. (1767). *Systema naturae*. Edition 12, 2: 1-736 + [8]. Holmiae.

Lucas, A.U.S. (1936). *The seaweeds of South Australia. Part I. Introduction and the green and the brown seaweeds*. 106 pp. Adelaide.

Martens, G. von. 1866 (1868). Die Tange. *In*: *Die Preussische Expedition nach Ost-Asien; Nach amtlichen Quellen*: Bot. Thiel, 152 pp. VIII Pls. Berlin. [Title page datd 1866, but published in 1868].

Martius, C.F.P. Von. (1828). *Icones plantarum cryptogamicarum Fasc*. I, pp. 1-30, pls. I-XIV. Monochium [Munich].

Menez, E.G., and H.P. Calumpong (1981). Phycological ressults of the Smithsonian Institution - Philippines Expeditions of 1978 and 1979 in Central Visayas, Philippines. *In*: *Proceedings of the Fourth International Coral Reef Symposium* [Manila 1981]. 2: 379-384.

Misra, J.N. (1966). *Phaeophyceae in India. I.C.A.R. Monograph on Algae*. [10] + 1-203. New Delhi.

Montagne, J.F.C. (1838-42). Botanique: Plantae Cellulaires. *In*: Histoire physique, politique et naturelle de l` Ile de Cuba par M. Ramond de Sagar. i-x + 1-540 pp., 15 taf. (Algae 1-104 pp.).

Montagne, J.F.C. (1840). Phytogeographia canariesnsis. Sectio ultima. Plantes cellulaires. *In*: *Histoire naturelle des Iles Canaries par Ph*. Barker-Webb et Sabin Berthelot. 3 (2): i-xv + 1-208 pp. 9 Pls. (This was not published earlier than 1841 as the Introduction dates 1841 whereas the cover dates 1840).

Nizamuddin, M. (1981). Contribution to the marine algae of Libya-Dictyotales. *Bibl. Phycol*. 54: 1-120, 39 pls. (J. Cramer). Vaduz.

Nizamuddin, M. and W. Lehnberg, (1970). Studies on the marine algae of Paros and Sikinos Islands, Greece. *Bot. Mar*. 13: 116-130.

Okamura, K. (1916). List of marine algae collected in Carolina and Mariana Islands, 1915. *Bot. Mag. Tokyo*, 30: 1-14.
Okamura, K. (1929). *Icones of Japanese algae*. 6 (1): 251-255 Pls. Tokyo. (Jan. 20, 1929).
Okamura, K. (1932). *Icones of Japanese algae*. 6 (6): 276-280 Pls. Tokyo. (Jan. 20, 1932).
Papenfuss, G.F. (1940). Notes on South African marine algae-I. *Bot. Notsiser*, 1940: 200-226.
Papenfuss, G.F. (1977). Review of the genera of Dictyotales (Phaeophycophyta). *Bull. Jap. Soc. Phycol*., 25: 271-287 (suppement) (August 1977).
Price, J.H. and D.M. John (1979). The marine benthos of Antigua (Lesser Antilles) II. An annotated list of algal species. *Bot. Mar*., 22 (5): 327-331.
Ramon, E. and I. Friedmann (1966). The gametophyte of *Padina* in the Mediterranean. *Proceed. Fifth Intern. Seaweed Symp*. 1965. Halifax. 183-196 pp.
Reinbold, Th. (1901). Marine algae. *In*: Flora of Koh Chang Contribution to the knowledge of the Gulf of Siam (J. Schmidt ed). *Bot. Tidsskr*., 24 (2): 187-201 (November).
Schiffner, V. (1916). *Studien uber Algen des Adriatischen Meeres. Wissen. Meeres*. N.F. 11: 128-198, Helgoland.
Schiffner, V. (1926). Beitrage zur Kenntnis der Meeresalgen. *Hedwigia*, 66: 293-320.
Schnetter, R. (1976). Marine algen der karibischen Kusten von Kolumbien-I. Phaeophyceae. *Bibl. Phycol*., 24: 1-125 (Herausgeb. J. Cramer).
Schnetter, R. and G. Bulla Meyer (1982). Marine algen der Pazifikkuste von Kolumbien. *Bibl. Phycol*., 60: i-xvii + 1-287.
Segawa, S. (1960). *Coloured illustrations of the seaweeds of Japan*. i-xviii, 1-175 pp. Osaka, Japan.
Setchell, W.A. (1926). Tahitian algae, collected by W.A. Setchell, C.B. Setchell and H.E. *Parks. Univ. Calif. Publs. Bot*., 12 (5): 61-142, Pls. 7-22. Berkeley.
Silva, P.C., E.G. Menes and R.L. Moe (1987). Catalog of the benthic marine algae of the Philippines. *Smiths. Contrib. Mar. Sci*. No. 27, 179 pp. Washington.
Sender, 0.G. (1846). Algae. *In*: *Plantae Preissians" Sive Enumeratio Plantarum quas in Australasia occidentali et Meridionali-occidentali Annis 1838-1841* (C. Lehman ed).. Collegit Ludovicus Preiss. vol. 2, pp. 148-160.
Sender, W. (1871). Die Algen des trophischen Australiens Abhandlungen aus dem Gebiete der Naturwissenschaften herausgegeben von dem naturwissenschaftlichen *Verein in Hamburg*.. 5: 33-74, Pls. i-vi. Hamburg.
Sender, G.O. (1880). Supplementum ad Vollumen undecinum. *In*: *Fragmentorum Phytographiae. I-Algae Australianae, hactenus Cognitae* (F. von Mueller ed). pp. 1-42. 105-107. Melbourne.
Srinivasan, K.S. (1969). *Phycologia indica (Icones of Indian marine algae).* 1: i-xix, 1-52 pp., 51. Pls. Bot. Surv. India, Calcutta.
Stafleu, F.A. and R.S. Cowan (1976). *Taxonomic Literature*. Vol. I, A-G, 1136 pp. 2nd. edition, Utrecht.
Stephenson, T.A. (1947). The constitution of the intertidal fauna and flora of South Africa. Part III. *Annals of the Natal Museum*. Vol. XV, Part 2.
Tanaka, T. (1960). *Studies on some marine algae from southern Japan*, III. Mem. Fac. Fish. Kagoshima Univ. 9: 91-105, 5 pls.
Tanaka T. and K. Nozawa (1962). Some notes on the genera *Padina* and *Zonaria* in the southwestern islands of Japan. *Mem. Fac. Fish. Kagoshima Univ*., 11 (2): 179-187, 2 pls.
Taylor, W.F. (1928). The marine algae of Florida, with special reference to the Dry Tortugas. *Papers Tortugas Lab. Carnegie Inst. Washington*, 25: 1-219.
Taylor, W.R. (1942). *Caribbean marine algae of the Allan Hancock Expeditions 1939*. Allan Hanc. Atlant. Exped. Rept. No. 2, Univ. South Calif. Publs. 193 pp. Los Angeles.
Taylor, M.R. (1945). *Pacific marine algae of the Allan Hancock Expeditions to the Galapagos islands*. Allan Hancock Paci. Exped. Univ. South. Calif. Publs. 12: i-iv + 1-528, 100 pls. Los Angeles.
Taylor, W.R. (1960). *Marine algae of the eastern tropical and subtropical coasts of the Americas*. Univ. Mich. Stud. Sci. Ser. 21, i-ix + [1] + 1-870 pp., 80 Pls. (1st Edition) Ann Arbor.
Taylor, W.R. (1966). Records of Asian and Western Pacific marine algae, particularly algae from Indonesia and the Philippines. *Pac. Sci*., 20: 342-359.
Taylor, W.R. (1969). Notes on the distribution of West Indian marine algae particularly in the Lesser Antilles, with a bibliography of recent works on eastern American tropical algae. *Contrib. from Univ. Mich. Herbarium*, 9 (2): 125-230. Aliens.
Thivy, F. (1959). On the morphology of the gametophytic generation of *Padina gymnospora* (Kuet.) Vickers. *J. Mar. Biol. Assoc. India*, 1 (l): 69-76.
Trevisan, V.B. Comite de (1849). Dictyoteis adumbratio. *Linnaea*, 22 (4): 421-464 (August 1849).

Trono, G.C. Jr. (1969). The marine benthic algae of the Carline islands. II. Phaeophyta and Rhodophyta. *Micronesica*, 5 (1): 25-121.

Trono, G.C. Jr. (1986). Philippine Seaweeds. [201-288]. *In*: *Guide to Phillipine flora and Fauna*. Vol. I, i-xviii, 382 pp.

Tseng, C.K. (1983). *Common Seaweeds of China*. 316 pp, Science Press, Beijing.

Tsuda, R.T. (1972). Marine benthic algae of Guam. I- Phaeophyta. *Microesica*, 8 (1+2): 87-115.

Tsuda, R.T. and F.O. Wray (1977). Bibliography of marine benthic algae in Micronescia. *Micronesica*, 13 (l): 85-120.

Velasquez, C.T., G.C. Trono and M.S. Doty (1975). Algal species reported from the Philippines. *Philip. J. Sci*., 101: 115-169.

Verheij, E. and W.F. Prud` homme van Reine (1993). Seaweeds of the Spennonde Archipelago, SW Sulawesi, Indonesia. *Blumea*, 37: 385-510.

Vickers, A. (1905). Lisle des algues marines de la Barbade. *Ann. Sci. Nat. Bot*. Ser., 9, 1: 45-66.

Vickers, A. (1908). *Phycalogia barbadensis - Iconographie des alguos marines recoltee a lile Barbade (Antilles*): Text by M.H. Shaw. Partie I I-Phaeophyceae. 33-44 pp. 34 Pls. Paris.

Weber, F. and D.M.H. Mohr (1804). *Naturhistorische Reise durch einen.* Theil Schwedens. i-xii + 13-207 pp, 3 pls. Gattingen.

Weber, Van Bosse, A. (1913). Liste des algues des Siboga. I: Myxophyceae Chlorophyceae, Phaeophyceae avec le concours de M. Th. *Reinbold. Siboga-Expeditie Monographie*, 59a: 1-186, 5 Pls, Leiden.

Weber, Van Bosse, A. (1928). Liste des algues du Siboga. Siboga-Exped. *Monographic* 59d, 4 (3): 393-533, Pls. XI-XVI. Leiden.

Womersley, H.B.S. (1966). Port Phillip Survey, 1957-1963, Algae. *Mem. natn. Mus. Vict*. No. 27, 133-156.

Womersley, H.B.S. (1967). A critical survey of the marine algae of southern Australia. II - Phaeophyta. *Aust. J. Bot*. 15: 189-270.

Womersley, H.B.S. (1984). *The marine benthic flora of southern Australia*. Part II. 484 pp. Adelaide.

Womersley, H.B.S. and A. Bailey (1970). Marine algae of the Soloman Islands. Phil. trans. Roy. Spc. London, *B. Biol*., 259: 257-352.

Yamada, Y. (1925). Studien uber die Meeresalgen von der Insel Formosa. II-Phaeophyceae. *Bot. Mag. Tokyo*, 39: 239-254.

Yamada, Y. (1931). Notes on some Japanese algae II. *J. Fac.Sci. Hokkaido Imp. Univ. Botany*, Ser. V, 1: 65-76, pls. XVI-XX.

Yamada, Y. (1944). A list of the marine algae from the Atoll of Ant. Sci. Paps. Inst. Algol. *Res. Fac. Sci. Hokkaido, Imp. Univ*., 3 (1): 31-45, 2 pls.

(*Accepted for publication February 2006*)