First Reports of *Padina antillarum* and *P. glabra* (Phaeophyta-Dictyotaceae) from Florida, with a Key to the Western Atlantic Species of the Genus

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**ABSTRACT.**—*Padina antillarum* (Kützing) Piccone and *P. glabra* Gaillard are newly reported for Florida. The first species, which has been widely reported from the Indo-Pacific under the name *P. tetrastromatica* Hauck, has seldom been reported from the Western Atlantic. The type locality of *P. antillarum* is Trinidad in the Lesser Antilles, and there are reports of its occurrence from Venezuela and Colombia. Observations are provided on tetrasporangiate and oogonial plants collected from Brevard County, Florida. *Padina glabra*, first described from Senegal, northwest Africa, has been collected on three occasions from Anastasia Island, Saint Augustine, St. Johns County, Florida. The Florida material agrees in most respects with the original description of *P. glabra* except for the larger size of the Florida thalli and the fact the thalli bear plantules in addition to sporangia. A key to the Western Atlantic species of *Padina* is provided.

**INTRODUCTION**

Wynne (1998b) presented evidence that *Padina tetrastromatica* Hauck, a frequently reported species in the Indo-Pacific and tropical West Africa, and *P. antillarum* (Kützing) Piccone, a poorly known taxon, are conspecific and that the latter name has priority. Collections of *P. antillarum* from P. Patrick Air Force beach, Brevard County, Florida, are herein reported and observations made on the vegetative and reproductive characteristics of this species of brown algae.

Up to now there have been reports of *Padina glabra* Gaillard only from the type locality in West Africa (Gaillard, 1966) and from southern India (Rengasamy & Anand, 1986). Thus, the identification of material from the northeast coast of Florida represents the first report of this species from the western Atlantic. A comparison with other species of the genus occurring in the western Atlantic with which *P. antillarum* and *P. glabra* might be confused is presented.

**MATERIALS AND METHODS**

The collection of *Padina antillarum* was made by Ted Klenk at P. Patrick Air Force Base beach (28° 13.9’ N, 80° 36’ W), 8 miles south of Cocoa Beach, Brevard County, Florida, on 15.vii.1998. The specimens were found floating in the drift. The collection of several plants has been deposited in the Herbarium of the University of Michigan (MICH).

Collections made on three occasions from the same locality in Florida are herein identified as *Padina glabra* Gaillard.

Anastasia Island, St. Augustine, St. Johns County, Florida:
2) legit Mary S. Snyder, ca. 1895-6 (MICH).
3) legit M. A. Howe no. 1189, 5.x.1902 (in NY); “on rocks of jetties at l. t. m. [= low tide mark] and below.”

Specimens that had been identified by M. A. Howe as *Padina antillarum* (or as that species with a query) were borrowed from NY and US for re-examination.

**RESULTS**

*Padina antillarum* (Kützing) Piccone
(Figs. 1-10)

The Florida collection of *P. antillarum* contained tetrasporangial and oogonial
thalli. The largest thallus (Fig. 1) measured 10.5 cm in height and an overall breadth of 11.5 cm, although the thallus was deeply split into segments 0.5-2.0 cm in width. The blades showed no calcification. Cross- and sagittal sections of the blades, both in mid-region and in more basal portions, showed a 4-layered organization (Figs. 4, 5). In tet-

Figs. 1-3. Padina antillarum. 1. Habit. 2. Surface view of inferior surface of tetrasporangial blade showing soral arrangement. 3. Surface view of superior surface of tetrasporangial blade showing scattered sporangia in the region between hair bands.
rasporangial and oogonial plants, reproductive organs occurred as pairs of concentric bands, each pair closely abutting a common hair-line (Fig. 2). These soral bands were well developed on the blade surface away from the circinnately inrolled apex of the thallus, as is characteristic of the genus. This surface was referred to as the lower side by Trono (1969) and Womersley (1987) and the inferior surface by Gaillard (1967). Gaillard’s terminology is followed in this paper. In sporangial plants, sporangia were also sometimes present on the superior side, but they were loosely scattered in the mid-region between the soral bands on the opposite (inferior) side (Fig. 3). The sporangia were not associated with hair bands, contrary to Gaillard’s (1967) observation that they may be associated with scattered hairs on the superior surface. Figure 10 represents a schematic view of a sectioned sporangial blade. In female thalli, an indusium covering the oogonia (Figs. 6, 7) is present, as depicted for this species by
Gaillard (1967). An indusium was not observed in tetrasporangial thalli (Figs. 8, 9).

Specimens in NY and US that had been assigned by M. A. Howe to Padina antillarum (sometimes with a “?”) were re-examined. None was found to be P. antillarum, but they were re-determined as P. boergeseni, P. haitiensis, P. sanctae-crucis, and P. boryana.

Padina glabra Gaillard (Figs. 11-21)

In working over collections of Padina in NY, the first author found a collection of hairless blades from Florida. This collection consisted of numerous entangled specimens mounted on a single herbarium sheet. Individual thalli measure 10-12 cm in height. Most thalli are deeply divided, individual segments being 2-3 cm wide (Fig. 11). There is no evidence of calcification. In sectional view blades consist of 3 to 4 cell layers (Figs. 17, 21). Cells on the superior and inferior thallus face are 48-62 μm long, 24-30 μm broad, and 25-27 μm high (Fig. 19). The central row(s) of cells possess the same width and length as the other cells, but their height varies. If 3 cell layers are present, the middle layer is approximately 50 μm high; if 4 cell layers are present, the middle cell seems to be divided into 2 cells, each 25 μm high. Sporangia are borne mainly on the superior face of the blade; less frequently sporangia are borne on the inferior face, but they do not occur in dense concentric sori. The sori lack indusia, and the absence of hairs is noteworthy (Figs. 16, 18). The uppermost sori contain sporangia (Fig. 20), but in a proximal direction the sori contain plantules apparently by a direct germination of the tetrasporangial mother cells (Figs. 12-15). These plantules are sometimes arranged as a pair of closely placed concentric rows (Fig. 12). Toward the base of the blade there is a gradual increase in the size of the plantules.

Our attention was drawn to Dangeard (1952) [see below] and the existence of a hairless Padina distributed as Phycodoea Boreali-Americana no. 580, specifically 580b, (“Padina durvillaei Bory”). In the two sets of PB-A 580b in MICH both specimens are hairless. These specimens (Fig. 11) bear sporangia in the sori located in the uppermost portion of the blade, and there is a gradual transition to the production of plantules in the older sori, as observed in collections made some years later by Howe from the same locality. These sporangia and resultant plantules often occur in a pair of closely associated concentric rows. The lack of calcification, the deeply divided blades, and the blade thickness of 3-4 cell layers point to the identity of PB-A 580b as P. glabra.

DISCUSSION

Padina antillarum and P. tetrastromatica were included in a recent checklist of benthic marine algae of the tropical and subtropical Western Atlantic (Wynne, 1998a). Gaillard (1967) published a detailed account of vegetative and reproductive observations on P. tetrastromatica, based both on three specimens in the type collection in Leiden and on recent specimens from Dakar, Senegal, West Africa. Gaillard (1967, fig. 1) designated one of the three specimens as the lectotype of P. tetrastromatica. The first account of P. antillarum was its description as Zonaria antillarum by Kützing (1859). Piccone (1886) transferred the species to Padina. The fact that Kützing did not provide information on its provenance may explain why Taylor (1960) did not include it in his marine benthic algal flora of the tropical western Atlantic. Wynne (1998b) examined the type specimen in MEL (National Herbarium of Victoria, Melbourne, Australia) and observed that the type locality was Trinidad in the Lesser Antilles, as the epithet “antillarum” suggests. Wynne also presented evidence that P. antillarum is taxonomically identical to P. tetrastromatica Hauck (1887), with a type locality of Meith, Somalia.

Padina antillarum is widely distributed in the Indian Ocean (Silva et al., 1996, as P. tetrastromatica as well as P. antillarum) and the tropical coast of West Africa (Lawson and John, 1987, as P. tetrastromatica). After the original description of the species, the only reports of P. antillarum in the western Atlantic are those by Schnetter (1976) from
Colombia and by Aponte and Ganesan cited by Ganesan (1990) from Venezuela (both records as \textit{P. tetrastromatica}). According to Thivy (1945), the report of \textit{P. tetrastromatica} by Setchell and Gardner (1930) and repeated by González-González et al. (1996) from Pacific Mexico is most likely \textit{P. crispata} Thivy in Taylor (1945).

\textit{Padina glabra} was described by Gaillard (1966) from Pointe de Fann, Dakar, Senegal,
northwest Africa. This is the only reported collection of this species from the west coast of Africa (Price et al., 1978). In a paper not mentioned by Gaillard (1966), Dangerard (1952) reported on various collections of Padina from Dakar, including some from Pointe de Fann (the type locality of P. glabra). He called attention to some specimens

of *Padina* that were four cell layers thick, had sporangial sori arranged in concentric circles generally associated in pairs, and were hairless. According to Dangeard, J. Feldmann confirmed his observations and suggested that a new genus could be erected for these specimens on the basis of the absence of hairs. Although Dangeard mentioned that the four-cell-layered construction suggested a relationship with *P. tetrastromatica* [= *P. antillarum*], he refrained from assigning a specific name. There is
little doubt that Dangeard was dealing with 
the species later described by Gaillard 
(1966) from the same location as P. glabra.

Dangeard (1952) called attention to the 
fact that a specimen of Padina that was 
distributed as Phycotheca Boreali-Americana 
no. 580, specifically 580b, (“Padina durvillaei 
Bory”) was hairless. PB-A 580b was a col-
collection made by Mrs. G. A. Hall, 20.vii.1896, 
from Anastasia Island, the identical loca-
tion of the M. A. Howe collection. Another 
shared feature is that these specimens bear 
propagula, developing in the place of spo-
rangia or from sporangia at a very young 
stage (“presumably before reduction divi-
sions occurs”). She indicated their occur-
resemblance in P. durvillei Bory and P. distromatica 
Hauck. These plantules have been noted 
also in P. pavonica by Bitter (1899) and 
Kuster (1899) and in P. gymnospora (Kütz.) 
Sonder by Hoyt (1920, as P. vickersiae), 
Hauck (1887), Gaillard (1967), and Lawson 
and John (1977) reported that thalli of P. 
antillarum (= P. tetrastrumatica) sometimes 
bear plantules arising in the same position 
as the tetrasporangial sori. Feldmann (1937) 
observed that Mediterranean plants of Dic-
tytota [Diloptus] fasciola (Roth) Lamouroux 
may bear plantules.

There is some similarity of the Florida 
Padina glabra to P. profunda, described by 
Earle (1969) from the Dry Tortugas of 
Florida, Gulf of Mexico, and also reported 
from offshore North Carolina (Schneider 
and Searles, 1973). According to Earle, 
blades of P. profunda are non-calcified and 
have faint piliferous zones with few hairs. 
Plants ranged in height from 10 to 25 cm. 
Blade thickness ranged from 2 cell layers 
the base. Reproductive plants were not ob-
erved.

Padina gymnospora (Kützing) Sonder has 
been the only species of the genus reported 
with confidence from the east coast of 
Florida (Moffler and Van Breedveld, 1979, 
as P. vickersiae; see Allender and Kraft, 
1983). Padina antillarum can be distin-
guished from P. gymnospora by the latter 
species’ thicker blades (6-8 layers in the 
basal region) and soral bands placed prox-
imal to each successive hair zone.

Schneider and Searles (1998) reviewed 
the many reports of marine algae sharing a 
distribution in the eastern and western 
tropical or subtropical Atlantic. This first 
report of Padina glabra from the western At-
lantic, thus significantly extending its 
range, is not surprising because many other 
algae have a similar distribution. The rarity

PADINA ANTILLARUM AND P. GLABRA FROM FLORIDA
of this species is an interesting question. Whether this apparent rarity of \textit{P. glabra} is real or merely the result of its being mistaken for other species remains unanswered.

Key to the species of \textit{Padina} known for the Western Atlantic\footnote{\textit{Padina profunda} is excluded due to lack of knowledge of fertile specimens, \textit{Padina crispata} Thivy in W.R. Taylor is also excluded; it ranges from Pacific Mexico to Pacific Colombia (Taylor, 1945; Schnetter and Bula Meyer, 1982), and its inclusion in Wynne’s (1998a) checklist is an error.}

1. Hairs and hair lines absent -- \textit{P. glabra}
1’. Hairs and hair lines present (at times difficult to detect because they may have been shed or are poorly developed, but their formation is revealed by the presence of concentric lines)------------------------- 2

2. Sporangial sori closely abutting the hair lines on both sides (the lower sporangial band often not well developed in \textit{P. pavonica}) ------------------ 3
2’. Sporangial sori not closely abutting the hairs lines----------------------- 4

3. Blades 3 cell layers (3-4 in basal region); superior surface of blade heavily calcified, inferior surface moderately calcified; sporangial sori with persistent indusium; gametophytes bisexual ----- \textit{P. pavonica}
3’. Blades 4 cell layers (3 in apical region; 6 in basal region); calcification absent or negligible; sporangial sori not indusiate; gametophytes unisexual ----------------- \textit{P. antillarum}

4. Blades 4 cell layers in mid frond; 6-8 cell layers near base; sori present between successive hair bands (alternating fertile and sterile zones absent) ------------------ \textit{P. gymnospora}
4’. Blades either 2 or 2-3 cell layers throughout; alternating fertile and sterile zones present------------------- 5

5. Blades 2 cell layers throughout..... 6
5’. Blades a mixture of 2 and 3 cell layers in same thalli ------- \textit{P. boergesenii}
6. Indusium not persistent; sporangial sori located in proximal region of fertile zone, just distal to hair lines----------------------- \textit{P. sanctae-cruis}
6’. Indusium persistent; sporangial sori in mid-region of hair lines--------- 7

7. Superior surface of blade heavily calcified and inferior surface very lightly calcified; surface cells of blade 25-38 \(\mu\)m wide; sporangia up to 120 \(\mu\)m in diameter --- \textit{P. haitiensis}\footnote{Gaillard (1975) suggested that \textit{P. haitiensis} is conspecific with \textit{P. sanctae-cruis}.}
7’. Both blade surfaces moderately calcified except for zones of hair bands; surface cells of blade 30-50 \(\mu\)m wide; sporangia up to 170 \(\mu\)m in diameter ---------------- \textit{P. perindusiata}

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LITERATURE CITED


Gaillard, J. 1966. Un \textit{Padina} nouveau des côtes