

## Taxonomic Reassessment of the Genus *Padina* (Dictyotales, Phaeophyta) from the Gulf of California

Rafael Riosmena-Rodriguez<sup>1\*</sup>, Litzia Paul-Chavez<sup>2</sup>, Gustavo Hernández-Carmona<sup>2</sup>,  
Juan Manuel López-Vivas<sup>1</sup> and Margarita Casas-Valdez<sup>2</sup>

<sup>1</sup>Programa de Investigación en Botánica Marina, Departamento de Biología Marina UABCS,  
Apartado postal 19-B, La Paz, B.C.S. 23080, México

<sup>2</sup>Centro Interdisciplinario de Ciencias Marinas IPN, La Paz B.C.S. 23080, México

A monographic reassessment of *Padina* Adanson species from the Gulf of California was developed based on an exhaustive review of the character and characters states that have been used to delimit species in recent and historically valuable collections. Eight names (*P. caulescens* Thivy in Taylor, *P. concrescens* Thivy in Taylor, *P. crispata* Thivy in Taylor, *P. durvillaei* Bory Saint-Vincent, *P. gymnospora* [Kützing] Sonder, *P. mexicana* Dawson, *P. tetrastromatica* Hauck and *P. vickersiae* Hoyt in Howe) were reported from the region. An analysis of 1,200 specimens led to the conclusion that only three species (*P. durvillaei*, *P. concrescens* and *P. mexicana*) can be recognized for the area based on four discriminating characters: presence of calcium carbonate in the cell wall; number of medullary cell layers in the basal area; number of medullary cell layers in the middle part and presence/absence of cortical cells. Comparative analysis of the species in the Gulf of California in relation to other recently evaluated species has shown a clear distinction among them suggesting *Padina* species were overestimated in our area.

**Key Words:** Dictyotales, Gulf of California, *Padina*, taxonomy

### INTRODUCTION

*Padina* Adanson and *Newhousia* G.W. Saunders, I.A. Abbott and Haroun, are the only genus of calcified brown algae (Allender and Kraft 1983; Huisman 2000; Kraft *et al.* 2004; De Clerk *et al.* 2006). *Padina* is a well defined genus that inhabits the tropics but extends to cool temperate waters and around 55 specific names have been described (Nic Dhonncha and Guiry 2002). Most species are poorly known, and many might prove to be taxonomic synonyms (Gaillard 1975; Lee and Kamura 1991). Some authors are of the opinion that only 30-32 species should be recognized (Wynne 1998), based on rigorously morphological and anatomical analysis in areas of the world where taxonomy has not updated.

In the Gulf of California, Howe (1911), based on 4 specimens collected by Gaston Vives for La Paz, identified *Padina durvillaei* and treated 3 specimens as *Padina* sp. Setchell and Gardner (1924a, b; 1925) based on their more extensive collections reported only *Padina*

*durvillaei*, but there is no evidence that they review the type. Dawson (1944) recognized *P. durvillaei* from Setchell and Gardner (1924a, b), but also described *Padina mexicana* because the presence/absence of calcification of the thalli. Thivy in Taylor (1945) described three new species of *Padina* (*P. caulescens*, *P. concrescens* and *P. crispata*) based on the distinction of the species in anatomical features (such as the number of cells in the basal area of the frond) but no comparisons with other contemporary recognized species was presented.

No other taxonomic analysis were done until Chávez (1980) analyzed the *Padina* species for México, in where she reported six species for the Gulf of California, but without a proper reassessment of the names or the features used to discriminate them. Around the same, and as part of floristic studies, three more names were added to the Gulf of California flora: *Padina tetrastromatica* Hauck (now *P. antillarum* [Kützing] Piccone), *P. gymnospora* (Kützing) Sonder and *P. vickersiae* Hoyt in Howe (Norris 1975; Mendoza-González and Mateo-Cid 1986; Mateo-Cid *et al.* 1993). In a recent taxonomic review based on historically relevant herbarium material for the Baja California Peninsula, Mateo-Cid *et al.* (2000a),

\*Corresponding author (riosmena@uabcs.mx)

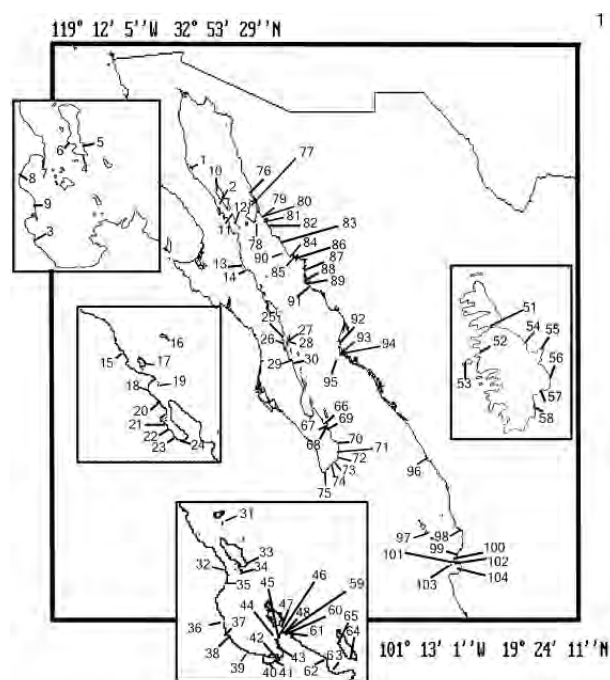
reached the conclusion that there were four species (*P. crispata* Thivy, *P. durvillaei*, *P. gymnospora* and *P. mexicana* Dawson) in the region. Their assessment, however, was based only in historically valuable collections but not type material. Another evaluation done by Ávila-Ortiz and Pedroche (2005) reviewed the taxonomy of this genus in the tropical Pacific of Mexico. However, in their assessment was based only on historically relevant material in relation to some type material and recent sporadic collections, but they suggested more species than Mateo-Cid *et al.* (2000b) for the area without a comparative analysis. Also, they proposed a new species for the area (*P. ramonribae*) but without a Latin diagnosis, making this name invalid (Art. 32 McNeil 2006). As part of our research in the area, we have found inconsistencies in the species, and recent and historically valuable collections were evaluated in relation to type material. Because of that, the aims of this study were: to evaluate how many species of *Padina* occur in the Gulf of California based on the evaluation of the characters and the characters states was used.

## MATERIAL AND METHODS

### Herbarium procedures

The present is a monographic evaluation as defined by Davis and Heywood (1963), in which an exhaustive review of the character and character states were used to delimit species was evaluated against recent collections and historically valuable collections in relation to the type material. Extensive collections were made along the Gulf of California (Fig. 1). The areas were carefully sampled from intertidal to subtidal regions of approximately 500 m<sup>2</sup>. All collected material was fixed in a solution of 4% formalin and sea water and transported to the laboratory. Once in the laboratory, all collections were used in character evaluations in terms of morphological, morphometric and anatomical features of vegetative and reproductive structures. Anatomical information was obtained from longitudinal sections made from hand sections and when was needed, histological sections were done using the same procedures as in Riosmena-Rodríguez *et al.* (1999).

After evaluation of the slides and plants, all material was housed in the Phycological Herbarium of the Universidad Autónoma de Baja California Sur (FBCS). Additional information was obtained from an analysis of historical material which included type material from the following herbaria: Herbarium of the University of



**Fig. 1.** Study area and sampling localities. Baja California; Ensenada de San Francisco (1), Canal de Ballenas (2), Bahía de los Ángeles (3), Isla Smith (4), Parte exterior (5), Zona Protegida (6), Punta la Gringa (7), La Silica (8), Tonyís Camp (9), Isla Ángel de la Guarda (10), Isla Partida (11), Isla Rasa (12), Baja California Sur; Bahía Santa Ana, El Racito (13), San Carlos (14), Santa Rosalía (15), Isla Tortuga (16), Isla San Marcos (17), Bahía Inés, Punta Inés (18), Isla San Ildefonso (19), Faro Mulegég (20), Bahía Concepción, Coyote (21), Requesón (22), Armenta (23), Las Pocitas (C, 24), Loreto (25), Puerto Escondido (26), Isla Carmen, Punta Cholla (27), Puerto Balandra (28), Bahía Agua Verde, Punta Pasquel (29), Roca Media (30), Isla San Diego (31), Bahía de la Paz, San Evaristo (32), Isla San José (33), Isla San Francisquito (34), El Coyote (35), San Juan de la Costa (36), El Camarón (37), El Sausozo (38), El Quelele (39), Ensenada de La Paz, La Paz (40), El Caimancito (41), La Concha (42), Pichilingue (43), Islote La Gaviota (44), Balandra (45), Tecolote (46), Canal de San Lorenzo (47), Calerita (48), Complejo Insular Espíritu Santo-La Partida, La Partida (49), El Candelero (50), La Ballena (51), El Faro (52), Pailebote (53), Punta Lobos (54), El Morrito (55), El Merito (56), Las Pilitas (57), El Pulguero (58), Punta Coyote (59), Bahía de la Ventana, El Sargento (60), La Ventana (61), Isla Cerralvo (62), Punta Viejos (63), Bahía de Muertos, Punta Arena (64), Punta Perico (65), Cueva de León (66), Ensenada de Muertos (67), Cabo Pulmo-Los Frailes (68), San José del Cabo (69), Punta Palmilla (70), Bahía Chilena (71), Cabo San Lucas, Cabeza de ballena (72), Punta Gorda (73), Sonora; Puerto Libertad (74), Bahía Agua Dulce, Isla Tiburón (75), Isla Turner (76), Bahía Kino (77), Puerta Rocosa (78), Isla Alcatraz (79), Los Tepetatitos (80), Roca Roja (81), Bahía San Francisquito (82), La Manga (83), Isla San Luis (84), Bahía Bacochibampo (85), Ensenada de Bacochibampo (86), Punta Colorado (87), Isla San Pedro Nolasco (88), Guaymas (89), Sinaloa; Laguna de Navachiste-Macapule, Cerro Negro (90), Bahía de Topolobampo (91), Punta Prieta (92), El Farallón (93), Mazatlán (94), Nayarit; Isla Ma. Magdalena (95), Ensenada el Carrizal (96), Sayulita (97), Careyeros (98), Bahía de Banderas, Punta Mita (99), Miramar (100), Las Marietas (101), Bajo de la Langosta (102).



**Figs 2-4.** *Padina caulescens*. Heterotypic synonym: *Padina durvillaei*. Morphology and anatomy of lectotype (PC). **Fig. 2.** Morphology of a plant in which multiple fronds can be observed. Scale bar: 1 cm. **Fig. 3.** Longitudinal section from apical area showing two medullary cell layers and one cortical (arrow). 20x. Scale bar = 30  $\mu\text{m}$ . **Fig. 4.** Longitudinal section from basal area showing two medullary cell layers and one cortical (arrow). 40x. Scale bar = 30  $\mu\text{m}$ .

California, Berkeley (UC which includes LAM and AHFH material); University of Michigan Herbarium (MICH), National Museum of Natural History, Paris (PC), Herbarium of the University of British Columbia, Herbarium of the Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional; Herbarium of the Universidad Autónoma de Baja California and the Herbarium of the FBCS.

#### Character evaluation

An exhaustive review of the character and character states used in the literature was composed. We categorized the features into morphological, morphometric and anatomical categories for vegetative and reproductive features carried out. For each specimen, we analyzed the morphological and anatomical characteristics (vegetative and reproductive) to establish if the characters were distinct or if they overlapped. For morphometric characters we took data such as total height, length and width of cells. With these observations and measurements of specimens, we elaborated a data base that now contains the



**Figs 5-7.** *Padina caulescens*. Heterotypic synonym: *Padina durvillaei*. Morphology and anatomy of isolectotype (PC). **Fig. 5.** Specimen composed of three plants with a distinctive stipitate blade (arrow). Scale bar = 1 cm. **Fig. 6.** Longitudinal section from the middle part of the thallus showing four medullary cell layers but no cortical (arrows). 20x. Scale bar = 40  $\mu\text{m}$ . **Fig. 7.** Longitudinal section from the basal part showing nine medullary cell layers (numbers), one cortical and a secondary holdfast (arrow). Scale bar = 40  $\mu\text{m}$ .

information from the analysis of the characters in the modern and historically valuable collections in relation to type material as used by Riosmena-Rodríguez *et al.* (1999). All specimens used for this study are listed in Appendix 1.

## RESULTS

The present study involved the comparative analysis of 12 characters using 1,200 specimens from recent collections, historically relevant collections and type material. As a result of our analysis, only four characters were found to be diagnostic (Table 1) to delimit three specific names: *Padina durvillaei* (Figs 2-12), *Padina concrescens* (Figs 13-20) and *Padina mexicana* (Figs 21-33).

#### Description of the species

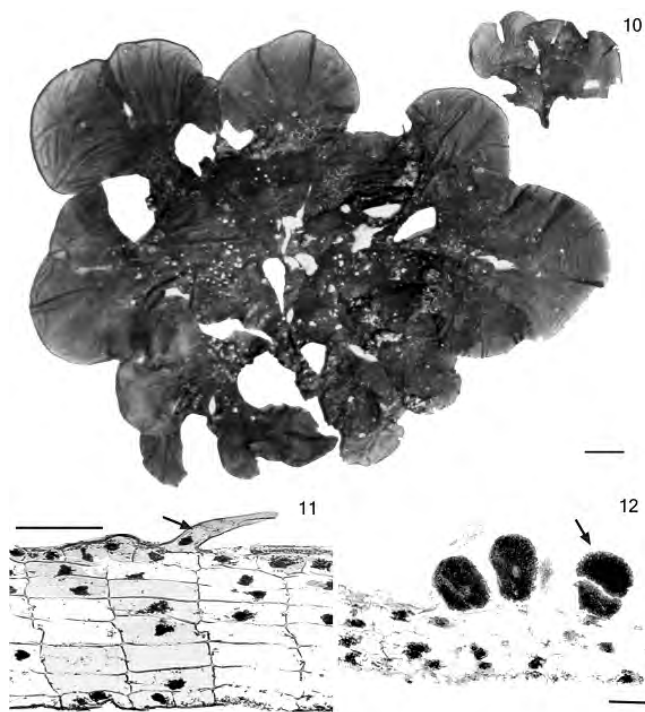
*P. durvillaei* Bory 1827:591, pl. 21: fig. 1

Figs 2-12, Table 1



**Figs 8-9.** *Padina caulescens*. Vegetative and reproductive morphology and anatomy features from isotype (UC). **Fig. 8.** Morphology of the plant showing a divided and epiphyted thallus. Scale bar = 1 cm. **Fig. 9.** Longitudinal section of the basal part that shows nine medullary cell layers, no cortical cells (arrow head) and the presence of secondary holdfast (arrow). 40x. Scale bar = 40  $\mu\text{m}$ .

**References:** Howe 1911:497; Setchell and Gardner 1924b:729; Setchell and Gardner 1925:661, pl. 93; Setchell and Gardner 1930:150; Dawson 1944:230; Taylor 1945:101; Dawson 1951:52; Dawson 1952:431; Dawson 1957:11; Dawson 1959b:19; Dawson *et al.* 1960:38, pl. 5: fig. 3; Dawson 1961:389; Dawson *et al.* 1964:22, pl. 18: fig. A; Dawson 1966a:11; Norris 1972:5; Chávez 1972:268; Brusca and Thomson 1975:42; Huerta-Múzquiz 1978:337; Chávez 1980:47; Pedroche and González-González 1981:65; Littler and Littler 1981:151; Schnetter and Bula-Meyer 1982:65, pl. 10: fig. I; Stewart and Stewart 1984:141; Huerta-Múzquiz and Mendoza-González 1985:46; Mendoza-González and Mateo-Cid 1985:24; Mendoza-González and Mateo-Cid 1986:421; Salcedo-Martínez *et al.* 1988:82; Sánchez-Rodríguez *et al.* 1989:41; Dreckmann *et al.* 1990:27; Rocha-Ramírez and Siqueiros-Beltrones 1991:31; Martínez-Lozano *et al.* 1991:23; Mateo-Cid *et al.* 1993:50; León-Tejeda and González-González



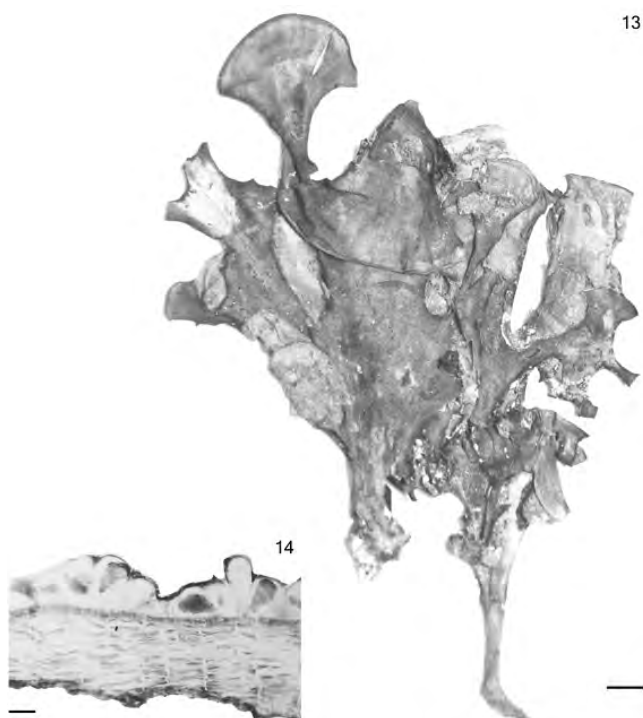
**Figs 10-12.** *Padina durvillaei*. Vegetative morphology and vegetative and reproductive anatomy of modern collections. **Fig. 10.** Specimens where we can observe the variability of the species. (Above right FBCS-6148, central FBCS-6139). **Fig. 11.** Longitudinal section where we can observe seven medullary cell layers, no cortical cells and a secondary holdfast (arrow) (FBCS-6139). 40x. Scale bar = 40  $\mu\text{m}$ . **Fig. 12.** Longitudinal section where we can observe the arrangement of the tetrasporangia. It shows one of them with its first division (arrow) (FBCS-6139). 20x. Scale bar = 40  $\mu\text{m}$ .

1993:200; González-González 1993:443; León-Tejeda and González-González 1993:497; Serviere-Zaragoza *et al.* 1993:482; Mateo-Cid and Mendoza-González 1994:50; Mendoza-González *et al.* 1994:110; González-González *et al.* 1996:156; Pacheco-Ruíz and Zertuche-González 1996b:171; Anaya-Reyna and Riosmena-Rodríguez 1996:862; Zertuche-González *et al.*, 1995: 456; Aguilar-Rosas, L. *et al.* 2000a:132; Mateo-Cid *et al.* 2000a:68; Mateo-Cid *et al.* 2000b:208 figs 48-50, 80-81, and 104; Aguilar-Rosas L. *et al.* 2000b:235; López *et al.* 2004:10; Riosmena-Rodríguez *et al.* 2005a:102; Hernández-Herrera *et al.* 2005:146; Mateo-Cid *et al.* 2006:49, 58; Serviere-Zaragoza *et al.* 2007:8; Pacheco-Ruíz *et al.* 2008:203.

**Type:** Isolectotype (Fig. 5) housed in Natural History of Paris Museum, Thuret Herbarium (TA9108).

**Type locality:** La Concepción, Chile Bory de Saint Vincent (19).

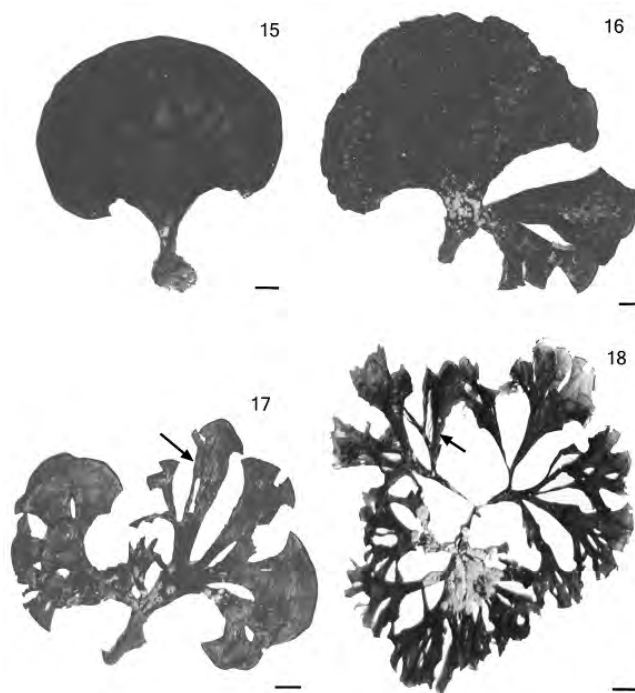
**Heterotypic synonym:** *Padina caulescens* Thivy in Taylor 1945:102; Dawson 1946a:29, 1946b:179, 1959:18,



**Figs 13-14.** *Padina conrescens*. Morphology and anatomy of vegetative and reproductive structures from isotype (MICH). **Fig. 13.** Plant morphology showing that the specimen is composed of an undivided blade. Scale bar = 1 cm. **Fig. 14.** Longitudinal section from the middle part showing nine medullary cell layers, two cortical cell layers and the arrangement of the tetrasporangial sori. 20x. Scale bar = 40  $\mu\text{m}$ .

1957:11, fig. 3, 1959a:5, 1961:389, 1961:407, pl. 7: fig. 2; 1962a:229, 1962b:53; 1962b:200, fig. 82; Chávez, 1980:48; Mendoza-González and Mateo-Cid 1986:421; Mateo-Cid and Mendoza-González 1992:23; 1994:43; Mateo-Cid *et al.* 1992:57; Serviere-Zaragoza *et al.* 1993:482; Mateo-Cid *et al.* 1993:50; León-Tejeda and González-González 1993:200; Mendoza-González *et al.* 1994:110; León-Álvarez and González-González 1995:363; González-González *et al.* 1996:155, fig. 18; Serviere-Zaragoza *et al.* 1998:171; Aguilar-Rosas *et al.* 2000a:132; Ávila-Ortíz and Pedroche 2005:143, figs 1-5, figs 2-12; Hernández-Herrera *et al.* 2005:146.

**Description:** Thallus growth form erect, height 10-15 cm and width 15-20 cm, with or without secondary holdfast (Figs 6, 9). Calcification absent on both sides. Reproductive structures arranged in sori over superficial areas on one or both sides. Anatomically, thallus composed of layers of cells reducing in number from the basal areas to the tips, medullary cells up to nine layers in the basal area (Figs 7, 9), and two in the apical portion, length 40-45  $\mu\text{m}$  and width 15-20  $\mu\text{m}$ ; one layer of corti-

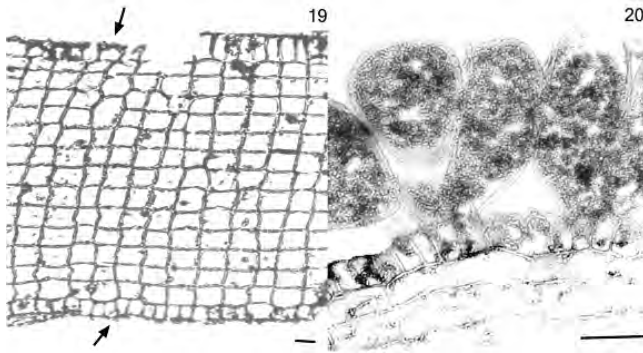


**Figs 15-18.** *Padina conrescens*. Morphological variability of the species. Variability of the species showing different degrees of splitting differentiation without calcification and rupture in some thalli (arrow) (**Fig. 15.** FBCS-61532; **Fig. 16.** FBCS-6158; **Fig. 17.** FBCS-6160; **Fig. 18.** FBCS-6154). Scale bar = 1 cm.

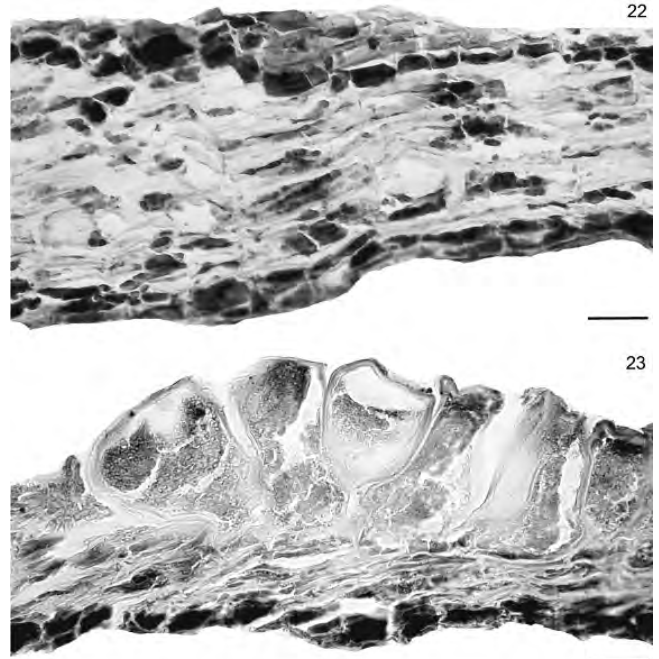
cal cells along the thallus when present (Fig. 7), length and width 15-20  $\mu\text{m}$ . Reproductive structures borne from cortical cells and organized in sori; sporangial sori (Fig. 12) 165-170 mm wide, composed of rounded sporangia length 60-65  $\mu\text{m}$  and width 40-45  $\mu\text{m}$ ; Oogonial sori width 170-175  $\mu\text{m}$ , composed of ovate oogonia, length 55-60  $\mu\text{m}$  and width 25-30  $\mu\text{m}$ ; male gametophytes not found.

**Nomenclature:** During the examination of the lectotype and isolectotype of *Padina durvillaei* (Figs 2-7) we found that the number of basal medullary cell layers was different between them (lectotype 2 layers [Fig. 4] and isolectotype 9 layers [Fig. 5]). Calcification and sori were absent in both. The analysis of the holotype of *P. caulescens* showed the same features as the isolectotype of *P. durvillaei* who is an older name and has priority. The differences between the lectotype of *P. durvillaei* and its isolectotype still need to be addressed when new collections from the type locality with reproductive structures and the possibility to explore molecular relationships become available in the future.

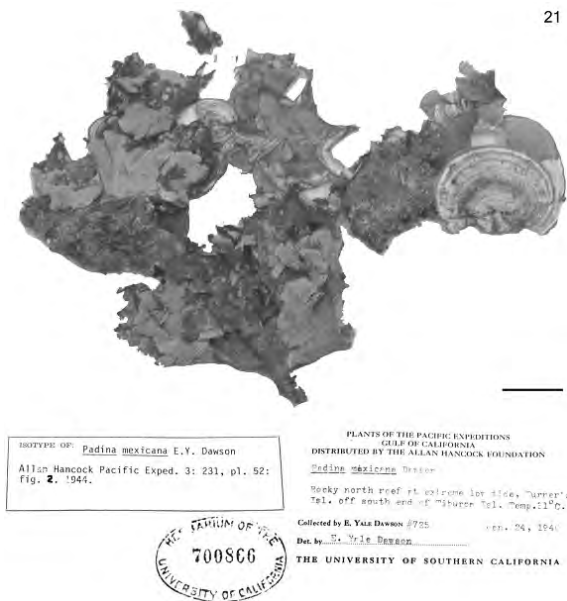
**Ecological and Geographical distribution:** We found this species from the north of the middle region to the



**Figs 19-20.** *Padina concrescens*. Vegetative and Reproductive anatomy. **Fig. 19.** Longitudinal section from basal part showing thirteen medullary cell layers and one cortical cell layer on each side (arrows) (FBCS-6154). 40x. Scale bar = 20  $\mu$ m. **Fig. 20.** Longitudinal section from the middle part showing the arrangement of oogonial sori (FBCS-6158). 40x. Scale bar = 40  $\mu$ m.



**Figs 22-23.** *Padina mexicana*. Vegetative and reproductive anatomy of the isotype (UC). **Fig. 22.** Longitudinal section from the middle part of the thallus showing four medullary cell layers with cortical cells on each side. 40x. Scale bar = 30  $\mu$ m. **Fig. 23.** Longitudinal section from the middle part of the thallus showing the arrangement of the tetrasporangial sori (arrows) 40x. Scale bar = 30  $\mu$ m.



**Fig. 21.** *Padina mexicana*. Vegetative morphology of isotype (UC). Specimen showing the overlapping disposition of the fronds and the prostrate growth form. Scale bar = 1 cm.

south region and along of the Mexican Pacific and have reports from the Galapagos Islands Taylor (1945). We found it both in the intertidal and subtidal zone in rocky substrates formed principally of mother rock. This species is sporadic and pseudo perennial depending on the locality, due to having reports in some seasons (spring and summer).

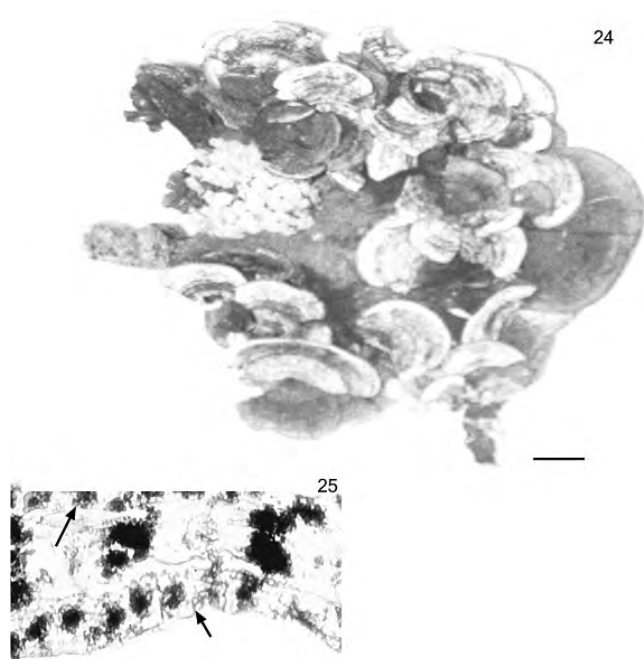
***Padina concrescens* Thivy in Taylor 1945:99.**  
Figs 13-20, Table 1.

**References:** Dawson 1959b:18-19, 1961:389, 1962b:53; Chávez 1980:48; González-González *et al.* 1996:155; Serviere-Zaragoza *et al.* 1998:171; Wynne 1998:285; Baynes 1999:424; Paul-Chávez and Riosmena-Rodríguez 2000:146; Cruz-Ayala *et al.* 2001:190. figs 13-20; Riosmena-Rodríguez *et al.* 2005a:34, 2005b:45.

**Type:** Holotype housed in LAM (Anderson 1991, now in UC) and isotype in MICH.

**Type locality:** Black Beach Anchorage, Isla Santa Maria, Galapagos, Ecuador Taylor (1945:102).

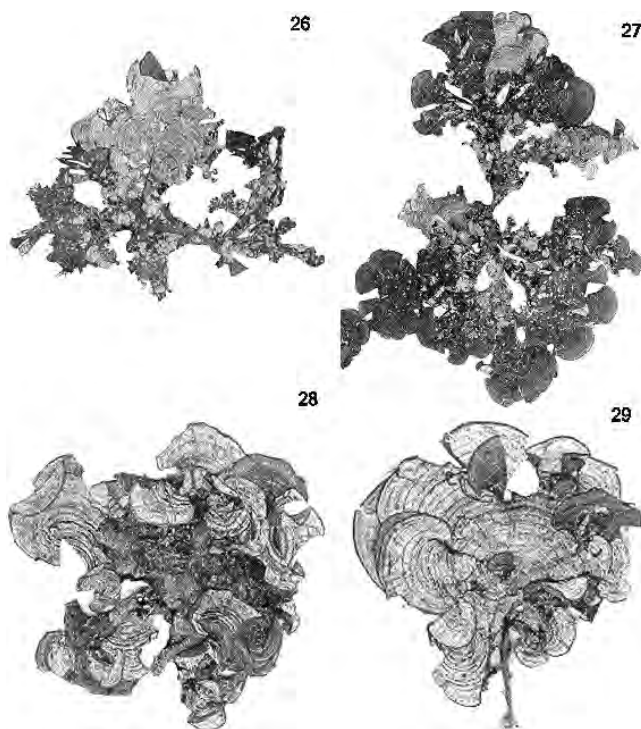
**Description:** Thallus grows erect, height 10-30 cm and width 15-40 cm, without secondary holdfast (Figs 14, 19). Calcification absent on both sides (Figs 13, 15-18). Reproductive structures arranged in sori over superficial areas on one or both sides. Anatomically, thallus composed of layers of cells reducing in number from the basal areas to the tips, medullary cells 10-20 layers in the basal area (Fig. 19), and two in the apical portion, length 30-40  $\mu$ m and width 15-25; two layers of cortical cells along the thallus (Figs 14, 19), length 30-35  $\mu$ m and width 20-25  $\mu$ m. Reproductive structures borne from cortical cells and organized in sori; sporangial sori (Fig. 14) width 220  $\mu$ m, composed of rounded sporangia length



**Figs 24-25.** *Padina mexicana*. Heterotypic synonym: *Padina crispata* Morphology and anatomy of vegetative structures from the isotype (MICH). **Fig. 24.** Plant morphology showing the overlapping arrangement of the thallus in a prostrate growth form. Scale bar = 1 cm. **Fig. 25.** Longitudinal section from the basal part showing five medullary cell layers and one cortical cell layer (arrow) in the lower portion. Scale bar = 30  $\mu$ m.

60-70  $\mu$ m and width 40-45  $\mu$ m; Oogonial sori (Fig. 20, same in the three species) width 200-220  $\mu$ m, composed of ovate oogonia, length 65-70  $\mu$ m and width 40-45  $\mu$ m; Male gametophyte were not found.

**Ecological and Geographical distribution:** This is the most common species of *Padina* in the Gulf of California and was found from the Gulf of Santa Clara, Sonora to Cabo San Lucas, B.C.S. In other regions it is reported along the Mexican Pacific and in the Galapagos Islands (Setchell and Gardner 1925; González-González *et al.* 1996). Principally found in the intertidal and subtidal zone, between 1 and 50 m deep. We found it in several habitats, including rocky and sandy areas and rhodolith beds. In the north it forms larger monospecific beds, but in the middle region it is associated with *Sargassum* beds, and in the southern region it is commonly associated with *P. mexicana* on rocky substrata. Its longevity might be considered as perennial or pseudo perennial because in some localities it has been reported for two or more consecutive years, but in others only one year or less. It grows from spring to summer, and disappears autumn to winter. We found both sporophytic and gametophytic



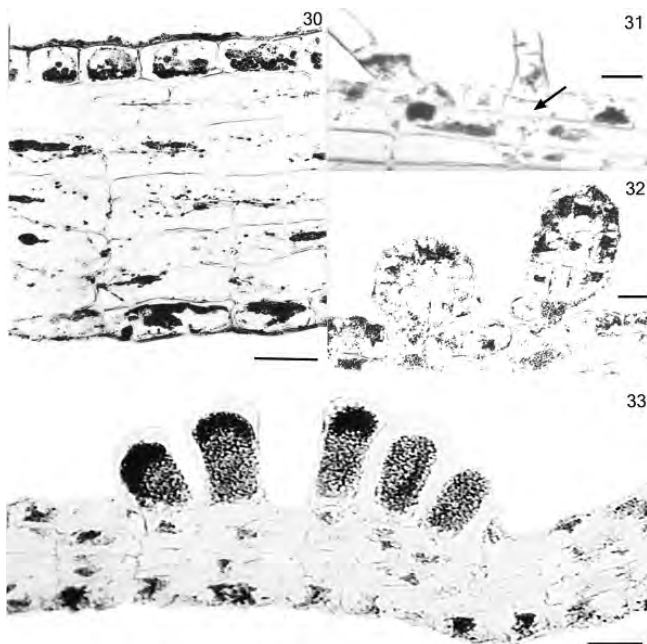
**Figs 26-29.** *Padina mexicana*. Vegetative morphology of recent collections. Morphological features from recent collections where different intensities of calcification were found in the plants ranging from a lightly calcified plant with erect and prostrate fronds (Fig. 26. FBCS-312) to heavily calcified plants with mostly prostrate fronds (Fig. 27. FBCS-4060). (Fig. 28. FBCS-6146, Fig. 29. FBCS-6127).

stages in the same locality.

*Padina mexicana* Dawson 1944:231, pl. 52, figs 2-6.

Figs 21-33, Table 1.

**References:** Dawson, 1946a:179, 1946b:179, 1948:227, 1954:115, 1959a:19, 1961:389, 1966a:11, 40, 1966b:56; Norris, 1975:116; Chávez 1980:48; Lawson and John 1977:131; Huerta-Múzquiz and Mendoza-González 1985:46; Mendoza-González and Mateo-Cid 1986:420, 1991:22; Rocha-Ramírez and Siqueiros-Beltrones 1991:23; Mateo-Cid and Mendoza-González 1991:24, 1992:23, 1994:43; Mateo-Cid *et al.* 1992:58; Mateo-Cid *et al.* 1993: 50; Mendoza-González *et al.* 1994:110; Anaya-Reyna and Riosmena-Rodríguez 1996:862; González-González *et al.* 1996:156; León-Tejeda *et al.* 1996:162; Pacheco-Ruíz and Zertuche-González, 1996a:4, 1996b:328; Riosmena-Rodríguez and Paul-Chávez 1997:23; Rodríguez-Morales and Siqueiros-Beltrones 1999:22; Aguilar-Rosas *et al.* 2000b:132; Paul-Chávez and Riosmena-Rodríguez 2000:146; Mateo-Cid *et al.* 2000a:69; 2000b:211; Cruz-Ayala *et al.* 2001:190; Ávila-Ortiz 2003:70, figs 1-9; López



**Figs 30-33.** *Padina mexicana*. Vegetative and reproductive anatomy of recent collections. **Fig. 30.** Longitudinal section showing nine medullary cell layers and one cortical (arrow). 40x. Scale bar = 30  $\mu\text{m}$ . **Fig. 31.** Longitudinal section showing a secondary holdfast borne from a cortical cell (arrow). 40x. Scale bar = 30  $\mu\text{m}$ . **Fig. 32.** Longitudinal section showing new plants in development (arrow). 40x. Scale bar = 30  $\mu\text{m}$ . **Fig. 33.** Longitudinal section showing a group of tetrasporangia and cellular arrangement. 20x. Scale bar = 30  $\mu\text{m}$ .

*et al.* 2004:10; Ávila-Ortiz and Pedroche 2005:158, figs 37-41(both varieties); Riosmena-Rodríguez *et al.* 2005a:102; Saad-Navarro and Riosmena-Rodríguez 2005:23, figs 21-33; Mateo-Cid *et al.* 2006:49; Pacheco-Ruíz *et al.* 2008:203.

**Type:** Holotype at LAM (Anderson 1991:12, now at UC).

**Type locality:** Isla Turner Reef, Isla Tiburón, Golfo de California Dawson (1944:231).

**Heterotypic synonym:** *Padina crispata* Thivy in Taylor 1945:100; Dawson 1946a:179, 1946b:179, 1948:245, 1954:115, 1961:389, 1962a:229, 1962b:53; Huerta-Múzquiz and Garza-Barrientos 1975:7; Chávez 1980:47; Schenetter and Bula-Meyer 1982:64; Mateo-Cid and Mendoza-González 1991:24, 1992:23; León-Álvarez and González-González 1995:363; León-Tejeda *et al.* 1996:162; González-González *et al.* 1996:156; Nuñez-López and Casas-Valdez 1998:423. *Padina mexicana* var. *erecta* Ávila-Ortiz 2003:70, figs 10-16.

**Misapplied names:** *Padina gymnospora* auct non. Setchell and Gardner 1924a:244; Norris 1975:235; Mendoza-González and Mateo-Cid 1986:421, 1991:22;

Mateo-Cid *et al.* 1993:50; León-Tejeda and González-González 1994:493; Ávila-Ortiz and Pedroche 1999:22. *P. vickersiae* auct non. Huerta-Múzquiz and Mendoza-González 1985:46.

**Description:** Thallus growth form erect or prostrate, height 50-150 mm and width 50-200 mm, and when prostrate has secondary holdfast (Fig. 31). Calcification present on both sides (Figs 21, 24, 26-29). Reproductive structures arranged in sori over superficial areas on one or both sides. Anatomically, thallus composed of layers of cells reducing in number from basal to apical areas, medullary cells 4-9 layers in the basal area (Figs 22, 30), and two in the apical portion, length 30-35  $\mu\text{m}$  and width 10-15; one or two layers of cortical cells along the thallus (Figs 22, 25, 30), length 30-35  $\mu\text{m}$  and width 20-25  $\mu\text{m}$ . Thallus dioeciously, reproductive structures borne from cortical cells and organized in sori; sporangial sori (Figs 23, 33) width 220-230  $\mu\text{m}$ , composed of rounded sporangia length 55-60  $\mu\text{m}$  and width 40-45  $\mu\text{m}$ ; Oogonial sori (Fig. 20) width 220  $\mu\text{m}$ , composed of ovate oogonia, length 50-55  $\mu\text{m}$  and width 40-45  $\mu\text{m}$ ; Male gametophytes not found.

**Nomenclature:** During the present study we examined the holotype material of *P. crispata* (Fig. 24) in which we found the same diagnostic features as in the type material of *P. mexicana* (Fig. 21) and concluded that they represents heterotypic synonyms. Also, Ávila-Ortiz and Pedroche (2005) have recognized two varieties for *P. mexicana* based on the prostrate vs. erect growth forms of the plants. Both types of growth-forms, however, can be easily observed in the same plant leaving no way to segregate them. As part of our efforts we found three misapplied names: *P. gymnospora*, *P. tetrastromatica* and *P. vickersiae* but after reviewed the plants on which the records are based we concluded that all of them represents *P. mexicana*.

**Ecological and Geographical distribution:** Although there are sporadic reports from northern and middle regions of the Gulf, the distribution of this species is principally in the south of the Gulf of California, extending into the Mexican Pacific where it is found growing in the intertidal zone, generally associated with *Padina concrescens*. Temporally, it is defined as a sporadic species, due to its presence being restricted to spring and summer, although, in some localities we found few thalli in winter. This species is present on sandy-rocky substrata and among pebbles. In other regions, this species has been reported in Pacific waters of Central Mexico and Colombia Dawson (1944) and in the tropical west of



**Table 1.** Comparative analysis of the species of *Padina* recently studied based on diagnostic features.

Species	Character	Presence of calcium carbonate	Medullary cells in the basal region	Medullary cells in the middle region	Cortical cells on both sides	Sori among interparilar zones	Position of phaeophycean hairs	References
<i>P. antillarum</i>	(Kuetzing) Piccone	No	1-4	2	Both	Successive	Alternate surfaces	Wynne and De Clerck 1999
<i>P. australis</i>	Hauk	Yes	2	2	One	Alternate	Alternate surfaces	Allender and Kraft 1983
<i>P. boergeresii</i>	Allender y Kraft	Yes	2-1	2	Both	Successive	Outer surface	Allender and Kraft 1983
<i>P. crassa</i>	Yamada	Yes	6-10	4	One	ND	Alternate surfaces	Wynne 1988
<i>P. fraseri</i>	(Greville) Greville	Yes	1	1	Both	Successive	Outer surface	Farrant and King 1989
<i>P. glabra</i>	Gaillard	No	1-4	2	One	ND	ND	Gaillard 1966
<i>P. gymnospora</i>	(Kuetzing) Sonder	Yes	6-8	4	Both	Alternate	Alternate surfaces	Womersley 1987
<i>P. mexicana</i>	Dawson	Yes	4-9	2-1	Both	Alternate	Alternate surfaces	This study
<i>P. tenuis</i>	Bory	Yes	2-1	2	One	Successive	Outer surface	Farrant and King 1989
<i>P. boryana</i>	Thivy in Taylor	No	2-1	2	Both	Successive	Outer surface	Farrant and King 1989
<i>P. caulencens</i>	Thivy in Taylor	No	Up to 9	1-4	One	Alternate	Alternate surfaces	This study
<i>P. conrencens</i>	Thivy in Taylor	No	10-20	10-11	Both	Alternate	Alternate surfaces	This study
<i>P. durvillaei</i>	(holotype) Bory	No	2-1	2	Both	ND	ND	This study
<i>P. durvillaei</i>	(isotype) Bory	No	8-9	1-4	Both	ND	ND	This study
<i>P. fernandeziana</i>		No	2	2	Both	Successive	Alternate surfaces	Geraldino et al 2005
<i>P. jonesii</i>		No	2	2	Both	Alternate	Alternate surfaces	Geraldino et al 2005
<i>P. minor</i>		No	2	2	Both	Successive	Alternate surfaces	Geraldino et al 2005
<i>P. moffittiana</i>		No	2	2	Both	Alternate	Alternate surfaces	Geraldino et al 2005
<i>P. sanctae-crucis</i>		No	2	2	Both	Alternate	Alternate surfaces	Geraldino et al 2005

ND, No determined.

Africa Wynne (1998).

## DISCUSSION

Historically, eight species (*P. caulescens*, *P. concrescens*, *P. crispata*, *P. durvillaei*, *P. gymnospora*, *P. mexicana*, *P. tetrastromatica* and *P. vickersiae*) and two varieties of *P. mexicana* (*P. mexicana* var. *erecta*, *P. mexicana* var. *mexicana*) were recognized for the Gulf of California. But based on the results of the present monograph only three specific names can be distinguished: *P. durvillaei*, *P. concrescens* and *P. mexicana*. This 70% reduction in the number of taxa is clearly a consequence of the lack of an appropriate set of characteristics to delimit the species. The present analysis has shown that four features can be used diagnostically: Presence/absence of calcium carbonate (CaCO<sub>3</sub>), number of medullar cell layers in the basal portion, number of medullar cell layers in the middle portion and cortical cell layers on both sides of the thallus (Table 1). Other modern monographic accounts (Allender and Kraft 1983; Womersley 1987; Farrant and King 1989; Wynne 1998; Littler and Littler 2000; Abbott and Huisman 2004; Geraldino *et al.* 2005) have produced a similar set of diagnostic features to delimit species: presence/absence of CaCO<sub>3</sub> and number of medullar cell layers in the basal/median region. However, these authors have not considered the presence/absence of cortical cell layers which are relevant when comparisons with other species are being made (Table 1). Also we found some consistent features as the arrangements of sporangial bands and the position of phaeophyceean hairs presented by Geraldino *et al.* (2005) are useful to discriminate this species in relation to other previously studied. A comparative analysis of the recognized species who deposit CaCO<sub>3</sub> (Table 1) have shown an overlapping in the number of medullar cells in the basal part of *Padina crassa* Yamada, *P. gymnospora* and *P. mexicana*. However, the first two species are separated from *P. mexicana* by the number of medullar cells in the middle part, but when we compare the presence or absence of the cortical cells, *P. crassa* is segregated of *P. gymnospora* and *P. mexicana* for the absence of these cells. In the case of the species that do not precipitated CaCO<sub>3</sub> (Table 1), *P. concrescens* and *P. durvillaei* is clearly distinguished due to the number of medullar and cortical cells. Another interesting observation, in relation to our study, is that the lectotype of *P. durvillaei* has similar features to *P. boryana* as Silva *et al.* (1996) and John *et al.* (2004) suggested. However, the lectotype of *P. durvillaei* is unfertile and

this is the only feature needed to be sure that they cannot be considered heterotypic synonyms. Within the group, the presence of cortical cells seems to be a relevant feature for distinguishing between them and the lack of information on the type of reproduction prevents suggestions of potential similarities or heterotypic synonyms.

Modern accounts of the genera has shown a high biodiversity (more than 10 species in each area) in temperate (Allender and Kraft 1983; Womersley 1987; Farrant and King 1989; Wynne 1998) and tropical (Littler and Littler 2000; Abbott and Huisman 2004; Geraldino *et al.* 2005) waters. In the case of the Gulf of California this low species number is might be related with the fact that this is a transitional zone in the worldwide genus distribution.

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Rome. pp. 10-82.

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## Appendix 1. Representative herbarium material used in the present monograph

### *Padina concrescens*

Holotype: María Magdalena (Thivy, 05. v. 1945, LAM # 245). **Northern Gulf: Isla San Esteban** (*P. durvillaei*, Fish y Game, 26-27. vi. 1960, Mich., ND). **Puerto Peñasco**, Sonora (*P. durvillaei*, P. Silva, iii. 1967, Mich., ND); (*P. durvillaei*, Dawson, 25. xii. 1972, Mich., ND); (*P. durvillaei*, J. Poindexter, iii. 1941, Mich., ND); (*P. durvillaei*, R. Riosmena-Rodríguez, 07. vi. 1999, FBCS. # 6150); (*P. durvillaei*, 05. vi. 1981. IMEX. # 1522). **Bahía Tepoca**, Sonora (*P. durvillaei*, 04. ii. 1940, Mich., ND). **Angel de la Guarda** (*P. durvillaei*, Dawson, 04. ii. 1940, Mich., ND). **Point Hughes on Cape San Lorenzo** (*P. durvillaei*, Taylor, 07. iii. 1967, Mich., ND). **Punta Lobos** (*P. durvillaei*, R. Riosmena-Rodríguez, 09. vi. 1999, FBCS. # 6151). **I. Tiburón** (*P. durvillaei*, 17. ix. 1965, IMEX. # 1524). **Bahía de los Angeles** (*P. durvillaei*, L. Ch-vez, 25. iii. 1997, FBCS. # 61532). **Canal de Ballenas** (*P. durvillaei*, R. Riosmena-Rodríguez, 02. vi. 1993, FBCS. # 6154); (*P. durvillaei*, G. Anaya R., 01. vi. 93, FBCS. # 308); (*P. durvillaei*, O. Holguín Q., 02. ii. 1966, ENCB-IPN # 3164). **Isla Turner** (*P. durvillaei*, R. Riosmena-Rodríguez, 04. vi. 1993. FBCS, # 6155). **Isla Raza** (*P. durvillaei*, R. Riosmena-Rodríguez, 08. vi. 1993, FBCS. # 6156). **Playa Santa Teresa** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 03. ii. 1995, ENCB-IPN # 13664); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 30. vii. 1996, ENCB-IPN # 13661); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 03. v. 1996, ENCB-IPN # 13662). **El Coloradito** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 22. ii. 1995, ENCB-IPN # 13671); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 05. v. 1995, ENCB-IPN # 13669); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 04. v. 1996, ENCB-IPN # 13668). **Puentecitos** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 04. ii. 1995, ENCB-IPN # 13670); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 03. v. 1996, ENCB-IPN # 13663). **Punta Tepoca** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 04. iii. 1972, ENCB-IPN # 10926). **Cabo Tepoca** (*P. durvillaei*, O. Holguín Q., 31. i. 1986, ENCB-IPN # 3165). **Isla Tiburón** (*P. durvillaei*, 17. ix. 1965, ENCB-IPN # 2075); (*P. durvillaei*, O. Holguín Q., 30. v. 1966, ENCB-IPN # 2456). **Puerto Libertad** (*P. durvillaei*, T. Alvarez, xii. 1958, ENCB-IPN # 1315). **San Francisquito** (*P. durvillaei*, Mateo-Cid y Flores, 09. iv. 1964, ENCB-IPN # 3468). **Isla Angel de la Guarda** (*P. durvillaei*, Arrington, 20. iv. 1966, ENCB-IPN # 699); (*P. durvillaei*, O. Holguín Q., 01. vi. 1966, ENCB-IPN # 3336). **Isla San Luis** (*P. durvillaei*, O. Holguín Q., 02. vi. 1966, ENCB-IPN # 2055.); (*P. durvillaei*, O. Holguín Q., 29. i. 1966, ENCB-IPN # 2066). **Las encantadas** (*P. durvillaei*, 23. ix. 1965, ENCB-IPN # 3825). **Estero Tepoca** (O. Holguín Q., 28. v. 1966, ENCB-IPN # 3170). **Middle Gulf: Nuevo Guaymas** (*P. durvillaei*, 05. iv. 1985, IMEX # 1523). **Guaymas, Sonora** (*P. durvillaei*, Dawson, 30. vi. 1040, Mich., ND); (*P. durvillaei*, Citlali G., 30. xii. 1991, ENCB-IPN # 7738); (*P. durvillaei*, Citlali G., 26. x. 1991, ENCB-IPN # 7790). **Bahía Concepción** (*P. durvillaei*, L. Paul-Chávez, 25. ii. 1997, FBCS. # 6130). (*P. durvillaei*, L. Paul-Chávez, 27. iii. 1997, FBCS. # 6134); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 13. iii. 1970, ENCB-IPN # 10926); (*P. durvillaei*, Mateo-Cid y Sánchez, 12. i. 1998, ENCB-IPN # 9716); (*P. durvillaei*, 26. v. 1966, ENCB-IPN # 3120); (*P. durvillaei*, Aguirre y Mateo-Cid, 22. v. 1990, ENCB-IPN # 11153); (*P. durvillaei*, Aguirre y Mateo-Cid, 23. v. 1990, ENCB-IPN # 11154); (*P. durvillaei*, Aguirre y Mateo-Cid, 22. v. 1990, ENCB-IPN # 11155); (*P. durvillaei*, Aguirre y Mateo-Cid, 23. v. 1990, ENCB-IPN # 11157). **Santa Rosalia** (*P. durvillaei*, L. Paul-Chávez, 28. iii. 1997, FBCS. # 6138). **Quino Nuevo** (*P. durvillaei*, R. Riosmena-Rodríguez, 21. vi. 1999, FBCS. # 6149); (*P. durvillaei*, Mateo-Cid y Flores, 18. x. 1991, ENCB-IPN # 7790). **Isla del Carmen** (*P. durvillaei*, ND, 06. vi. 1993, FBCS. # 6157); (*P. durvillaei*, O. Holguín Q., 26. v. 1966, ENCB-IPN # 2056). **Requezón** (R. Riosmena-Rodríguez, 03. iv. 1991, FBCS. # 6158). **Armenta** (*P. durvillaei*, G. Anaya R., 26. x. 90, FBCS. # 320). **Topolobampo** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 05. x. 1986, ENCB-IPN # 9081). **Bahía Quino** (*P. durvillaei*, Guzmán, 07. vi. 1961, ENCB-IPN # 1535); (*P. durvillaei*, Mateo-Cid y Flores, ENCB-IPN # 7739); (*P. durvillaei*, Mateo-Cid y Flores, 18. x. 1983, ENCB-IPN # 7742); (*P. durvillaei*, Mateo-Cid y Flores, 17. x. 1983, ENCB-IPN # 7473); (*P. durvillaei*, O. Holguín Q., 05. ii. 1966, ENCB-IPN # 1995). **Punta colorada** (*P. durvillaei*, O. Holguín Q., 12. iv. 1966, ENCB-IPN # 3120). **Southern Gulf: Punta Perico** (*P. durvillaei*, L. Paul-Chávez, 07. ii. 1997, FBCS. # 6127); (*P. durvillaei*, L. Paul-Chávez, 07. ii. 1994., FBCS. # 6229); (*P. durvillaei*, L. Paul-Chávez, 19. iv. 1997, FBCS. # 6137); (*P. durvillaei*, L. Paul-Chávez, 02. v. 1993. FBCS. # 6228); (*P. durvillaei*, R. Riosmena-Rodríguez, 09. iii. 1994, FBCS. # 6159); (*P. durvillaei*, R. Riosmena-Rodríguez, 04. vi. 1994, FBCS. # 6160); (*P. durvillaei*, R. Riosmena-Rodríguez, 25. iv. 1994, FBCS. # 6161); (*P. durvillaei*, R. Riosmena-Rodríguez, 25. vi. 1994, FBCS. # 6162); (*P. durvillaei*, R. Riosmena-Rodríguez, 01. x. 1994, FBCS. # 6163); (*P. durvillaei*, R. Riosmena-Rodríguez, 13. iii. 1994, FBCS. # 6164); (*P. durvillaei*, R. Riosmena-Rodríguez, 26. ix. 1996, FBCS. # 6165). **Calerita** (*P. durvillaei*, E. Rodríguez-Morales. 19. iv. 1997. FBCS. #

6128); (*P. durvillaei*, R. Riosmena-Rodríguez, 15. iii. 1997, FBCS. # 6129); (*P. durvillaei*, 17. iii. 1994, FBCS. # 6230); (*P. durvillaei*, R. Riosmena-Rodríguez, 12. v. 1989, FBCS. # 6166); (*P. durvillaei*, ND, 10. v. 1994, FBCS. # 6167); (*P. durvillaei*, 09. iv. 1994, FBCS. # 6168); (*P. durvillaei*, E. Rodríguez-Morales, 11. vi. 1994, FBCS. # 6169); (*P. durvillaei*, E. Rodríguez-Morales, 05. v. 1994, FBCS. # 6170); (*P. durvillaei*, E. Rodríguez-Morales, 01. v. 1994, FBCS. # 6171); (*P. durvillaei*, E. Rodríguez-Morales, 12. v. 1994, FBCS. # 6172); (*P. durvillaei*, E. Rodríguez-Morales, 04. v. 1994, FBCS. # 6173); (*P. durvillaei*, E. Rodríguez-Morales 09. vii. 1994, FBCS. # 6174); (*P. durvillaei*, E. Rodríguez-Morales, 27. viii. 1994, FBCS. # 6175); (*P. durvillaei*, R. Riosmena-Rodríguez, 08. v. 1990, FBCS. # 6176); (*P. durvillaei*, R. Riosmena-Rodríguez, 22. ii. 1991, FBCS. # 6177); (*P. durvillaei*, R. Riosmena-Rodríguez, 26. iv. 1991, FBCS. # 6178); (*P. durvillaei*, R. Riosmena-Rodríguez, 24. viii. 1990, FBCS. # 6179); (*P. durvillaei*, R. Riosmena-Rodríguez, 10. v. 1991, FBCS. # 6180); (*P. durvillaei*, R. Riosmena-Rodríguez, 15. x. 1988, FBCS. # 397); (*P. durvillaei*, R. Riosmena-Rodríguez, 26. viii. 1988, FBCS. # 414); (*P. durvillaei*, R. Riosmena-Rodríguez, 24. ii. 1989, FBCS. # 419). **El Camarón** (*P. durvillaei*, L. Paul-Chávez, 08. iii. 1997, FBCS. # 6136). **San Rafael** (*P. durvillaei*, 23. vii. 1999, FBCS. # 6142). **El Coyote** (*P. durvillaei*, R. Riosmena-Rodríguez, 02. iv. 1991, FBCS. # 6181). **Bahía de las Animas** (*P. durvillaei*, R. Riosmena-Rodríguez, 03. vi. 1993, FBCS. # 6182). **Balandra** (*P. durvillaei*, L. Paul-Chávez, 25. iv. 1993, FBCS. # 6183); (*P. durvillaei*, R. Urapiti-Rivera, 01. ix. 1994, FBCS. # 6184); (*P. durvillaei*, Riosmena-Rodríguez, 10. iii. 1994, FBCS. # 6185); (*P. durvillaei*, R. Riosmena-Rodríguez, 09. iv. 1994, FBCS. # 6186); (L. Paul-Chávez, 07. v. 1994, FBCS. # 6187); (R. Riosmena-Rodríguez, 11. vi. 1994, FBCS. # 6188); (*P. durvillaei*, R. Riosmena-Rodríguez, 10. v. 1994, FBCS. # 6189); (*P. durvillaei*, R. Riosmena-Rodríguez, 18. viii. 1988, FBCS. # 6190); (*P. durvillaei*, R. Riosmena-Rodríguez, 09. vii. 1994, FBCS. # 6191); (*P. durvillaei*, R. Riosmena-Rodríguez, 24. ii. 1989, FBCS. # 6192); (*P. durvillaei*, R. Riosmena-Rodríguez, 06. v. 1988, FBCS. # 6193); (*P. durvillaei*, R. Riosmena-Rodríguez, 04. v. 1996, FBCS. # 6194). **El Sargento** (*P. durvillaei*, R. Urapiti-Rivera, 15. iii. 1994, FBCS. # 6195); (*P. durvillaei*, C. Armenta, 10. v. 1994, FBCS. # 6196); (*P. durvillaei*, R. Urapiti-Rivera, 16. v. 1994, FBCS. # 6198); (*P. durvillaei*, C. Armenta, 18. vi. 1994, FBCS. # 6197); (*P. durvillaei*, C. Armenta, 13. vii. 1994, FBCS. # 6199); (*P. durvillaei*, C. Armenta, 10. v. 1994, FBCS. # 6200); (*P. durvillaei*, R. Riosmena-Rodríguez, 05. ii. 1994, FBCS. # 485). **Morrito** (*P. durvillaei*, R. Riosmena-Rodríguez, 15. ii. 1991, FBCS. # 6201); (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6203). **San Gabriel** (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6204); (*P. durvillaei*, R. Riosmena-Rodríguez, 09. v. 1990, FBCS. # 6205); (*P. durvillaei*, R. Riosmena-Rodríguez, 13. ix. 1991, FBCS. # 6206). **Candelero** (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6207); (*P. durvillaei*, R. Riosmena-Rodríguez, 13. ix. 1991, FBCS. # 6208). **Los Islotes** (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6231). **Punta Sur** (*P. durvillaei*, R. Riosmena-Rodríguez, 09. v. 1990; FBCS. # 6209). **El Cardonal** (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6210). **La Partida** (*P. durvillaei*, R. Riosmena-Rodríguez, 09. v. 1990, FBCS. # 6211). **Isla Cerralvo** (*P. durvillaei*, M. Medina, 10. v. 1994, FBCS. # 6212); (*P. durvillaei*, R. Riosmena-Rodríguez, 5. ii. 1994, FBCS. # 502). **La Lobera** (*P. durvillaei*, R. Riosmena-Rodríguez, 09. v. 1990, FBCS. # 2213); (*P. durvillaei*, M. Medina, 30. viii. 1994, FBCS. # 6214). **Pailebote** (*P. durvillaei*, R. Riosmena-Rodríguez, 13. ix. 1991, FBCS. # 6215); (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6216). **El Faro** (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6217); (*P. durvillaei*, R. Riosmena-Rodríguez, 13. ix. 1991, FBCS. # 6218). **Ballena** (*P. durvillaei*, R. Riosmena-Rodríguez, 17. v. 1991, FBCS. # 6232). **Los Cerritos** (*P. durvillaei*, R. Riosmena-Rodríguez, 30. v. 1994, FBCS. # 6219). **Los Tronados** (*P. durvillaei*, R. Riosmena-Rodríguez, 15. x. 1990, FBCS. # 6220). **Punta Prieta** (*P. durvillaei*, R. Riosmena-Rodríguez, 14. iii. 1991, FBCS. # 6221). **Punta Arenas** (*P. durvillaei*, R. Riosmena-Rodríguez, 07. ii. 1996, FBCS. # 6222). **San Juan de la Costa** (*P. durvillaei*, R. Riosmena-Rodríguez, 22. v. 88, FBCS. # 205); (*P. durvillaei*, Riosmena-Rodríguez, 10. v. 88, FBCS. # 290). (*P. durvillaei*, R. Riosmena-Rodríguez, 20. vii. 89, FBCS. # 3156). **Playa Guayabitos** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 23. xi. 1987, ENCB-IPN # 6931); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 23. vii. 1987, ENCB-IPN # 9074). **San José del Cabo** (*P. durvillaei*, A. Ramírez, 27. ix. 1981, ENCB-IPN # 5265). **Todos Santos** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 19. x. 1989, ENCB-IPN # 13666); (*P. durvillaei*, Mateo-Cid y Aguirre, 04. viii. 1989, ENCB-IPN # 13667); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 12. iii. 1998, ENCB-IPN # 10914). **Cabo Pulmo** (*P. durvillaei*, Mateo-Cid y Sánchez, 03. ii. 1984, ENCB-IPN # 11364). **Paseo Claussen** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 26. vii. 1987, ENCB-IPN # 9090). **Cerro las Gallinas** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 02. x. 1986, ENCB-IPN # 9089). **Cerro Don Carlos** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 04. x. 1986, ENCB-IPN # 9088). **Mazatlán** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 25. vii. 1987, ENCB-IPN # 9087); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 26. vii. 1987, ENCB-IPN # 9086); (*P. durvillaei*, Mendoza-González y Mateo-Cid, 25. x. 1983, ENCB-IPN # 9082). **Bahía de La Paz** (*P. durvillaei*, O. Holguín Quiñones,



19. v. 1966, ENCB-IPN # 2005); (*P. durvillaei*, O. Holguín Quiñones, 13. iv. 1966, ENCB-IPN # 2177). **Cabo San Lucas** (*P. durvillaei*, Pilar Piña, 24. v. 1976, ENCB-IPN # 4576). **Nayarit** (*P. durvillaei*, L. Larios, 02. vi. 1984, ENCB-IPN # 4994). Golfo sur (*P. durvillaei*, 29. ix. 1965, ENCB-IPN # 2037). **Sonora** (*P. durvillaei*, González y Mallón, 06. v. 1965, ENCB-IPN # 3350). **Loreto** (*P. durvillaei*, Guzmán, 01. ii. 1958, ENCB-IPN # 1237). **Sinaloa** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 25. vii. 1987, ENCB-IPN # 10925).

*Padina caulescens*.

**Holotype** Isla Santa María (Thivy, 30. i. 1934, LAM # 245); **Northern Gulf: Playa Santa Teresa** (*P. durvillaei*, Mendoza-González y Mateo-Cid, 21. x. 1995, ENCB-IPN # 13665); **Bahía de los Angeles** (*P. gymnospora*, 19. ix. 1965, ENCB-IPN # 3168). **Middle gulf: Guaymas** (*P. durvillaei*, Citlali G, 27. x. 1991, ENCB-IPN # 7741). **Bahía Concepción** (*P. gymnospora*, O. Holguín Quiñones, 27. vii. 1966, ENCB-IPN # 3956). Southern gulf: **San Rafael** (R. Riosmena-Rodríguez, 23. vii. 1999, FBCS. # 6139); (R. Riosmena-Rodríguez, 11. vii. 1999, FBCS. # 6148). **Bahía de La Paz** (*P. durvillaei*, O. Holguín Quiñones, 10. xi. 1966, ENCB-IPN # 2952); (*P. durvillaei*, O. Holguín Quiñones, 10. xi. 1966, ENCB-IPN # 3126); (*P. gymnospora*, Flores, 01. vi. 1982, ENCB-IPN # 4757). **Isla San Juan Nepomuceno** (*P. durvillaei*, O. Holguín Q., 13. iv. 1966, ENCB-IPN # 3306). **San Rafael** (R. Riosmena-Rodríguez, 23. vii. 1999, FBCS. # 6140); (R. Riosmena-Rodríguez, 11. vii. 1999, FBCS. # 6142); (*P. durvillaei*, 07. vi. 1966, ENCB-IPN # 3331); **Mazatlán** (*P. durvillaei*, Tirado, i. 1971, ENCB-IPN # 3463).

*Padina mexicana*.

**Holotype: XXX; Isotipo** Golfo dulce (*P. crispata*, Taylor, 26. iii. 1939, LAM # 21497); **Northern Gulf Isla Tiburón** (Dawson, 24. v. 1940, Mich., ND). **Bahía de los Angeles** (G. Anaya R., 01. vi. 93, FBCS. # 312). **Alto Golfo** (*P. gymnospora*, Mendoza-González y Mateo-Cid, 30. vii. 1996, ENCB-IPN # 13679); (*P. gymnospora*, Mendoza-González y Mateo-Cid, 21. vii. 1996, ENCB-IPN # 13678). **Middle gulf: Quino Nuevo** (R. Riosmena-Rodríguez, 07. vi. 1999, FBCS. # 6146). **Requezón** (V. Rocha, 26. x. 1989, FBCS. # 1770). **Bahía Concepción** (Mateo-Cid y Aguirre, 22. v. 1990, ENCB-IPN # 11163). **Southern gulf: Punta Perico** (L. Paul-Chávez, 09. iii. 1994, FBCS. # 5821); (L. Paul-Chávez, 07. ii. 1994, FBCS. # 6127); (L. Paul-Chávez, 25. vi. 1994, FBCS. # 4262). **Calerita** (E. Rodríguez-Morales, 24. vii. 1990, FBCS. # 1990); (E. Rodríguez-Morales, 09. vii. 1994, FBCS. # 4469); (E. Rodríguez-Morales, 08. v. 1990, FBCS. # 4461); (C. Armenta, 26. vii. 1988, FBCS. # 3296); (E. Rodríguez-Morales, 27. viii. 1994, FBCS. # 4456); (R. Riosmena-Rodríguez, 08. ix. 1989, FBCS. # 2450); (L. Paul-Chávez, 09. vi. 1997, FBCS. # 6137); (R. Riosmena-Rodríguez, 11. vi. 1994, FBCS. # 6223); (R. Riosmena-Rodríguez, 27. viii. 1994, FBCS. # 6224); (R. Riosmena-Rodríguez, 24. iv. 1994, FBCS. # 37). **Isla Cerralvo** (R. Riosmena-Rodríguez, 10. v. 1994, FBCS. # 4837); (M. Medina, 10. v. 1994, FBCS. # 3802); (M. Medina, 30. viii. 1994, FBCS. # 4457); (R. Riosmena-Rodríguez, 14. ix. 1994, FBCS. # 40). **San Juan de la Costa** (R. Riosmena-Rodríguez, 15. v. 1994, FBCS. # 4836); (R. Riosmena-Rodríguez, 15. v. 1992, FBCS. # 3025). **El Sargento** (R. Urapiti-Rivera, 13. vii. 1994, FBCS. # 4463); (R. Urapiti-Rivera, 18. vi. 1994, FBCS. # 4060); (R. Riosmena-Rodríguez, 25. x. 1980, FBCS. # 2822); (R. Riosmena-Rodríguez, 18. x. 1980, FBCS. # 2821); (R. Urapiti-Rivera, 10. v. 1994, FBCS. # 3803); (R. Riosmena-Rodríguez, 27. iv. 1992, FBCS. # 2820); (R. Riosmena-Rodríguez, 26. iv. 1992, FBCS. # 3026); (R. Urapiti-Rivera, 13. vii. 1994, FBCS. # 4463). **Balandra** (R. Urapiti-Rivera, 09. vii. 1994, FBCS. # 4459); (R. Riosmena-Rodríguez, 25. ix. 1984, FBCS. # 450); (R. Riosmena-Rodríguez, 21. ix. 1984, FBCS. # 9); (R. Riosmena-Rodríguez, 08. xi. 1980, FBCS. # 6225). **La Concha** (R. Riosmena-Rodríguez, 22. v. 1994, FBCS. # 4264); (R. Riosmena-Rodríguez, 22. v. 1992, FBCS. # 2708). **Punta Perico** (L. Paul-Chávez, 25. iv. 1994, FBCS. # 4263); (R. Riosmena-Rodríguez, 04. iii. 1994, FBCS. # 33). **El Caimancito** (R. Riosmena-Rodríguez, 06. iii. 1993, FBCS. # 3404); (R. Riosmena-Rodríguez, 24. iv. 1989, FBCS. # 2557); (R. Riosmena-Rodríguez, 24. iv. 1983, FBCS. # 6226). **San Rafael** (R. Riosmena-Rodríguez, 23. vii. 1999, FBCS. # 6147); (R. Riosmena-Rodríguez, 11. vii. 1999, FBCS. # 614). **Ensenada de Muertos** (G. Saad-Navarro, 25. vi. 1994, FBCS. # 4061); (V. Rocha Ramírez, 3. vii. 87, FBCS. # 3157); (R. Riosmena-Rodríguez, 04. iii. 1994, FBCS. # 31). **Malecón La Paz** (G. Velazquez, 27. iv. 1992, FBCS. # 2707). **El Saladito** (R. Riosmena-Rodríguez, 27. v. 1992, FBCS. # 2705). **El Camarón** (L. Paul-Chávez, 28. iv. 1997, FBCS. # 6133). **Bahía de La Paz** (15. V. 1992, FBCS. # 6227); (*P. crispata*, M. L. Chávez, 08. x. 1988, ENCB-IPN # 5265). **Isla San José** (G. Anaya R., 11. i. 91, FBCS. # 3158). Cabo Pulmo (G. Anaya R, 25. iv. 88, FBCS. # 3159). **Guayabitos, Nayarit** (*P. crispata*, Mendoza-González y Mateo Cid, 23. vii. 1987, ENCB-IPN # 2952). **El Tecolote** (Chávez, 10. viii. 1979, ENCB-IPN # 4801); **Todos Santos** (Mateo-Cid y Aguirre, 15. ix. 1985, ENCB-IPN # 9717). **San José del Cabo** (Mendoza-González y Mateo-Cid, 11. xii. 1988, ENCB-IPN # 7117).

