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A Field Key to the Identification of Tropical Western Atlantic Zooxanthellate Octocorals (Octocorallia: Cnidaria)

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ABSTRACT.—Despite their abundance and ecological importance, octocorals have received relatively little taxonomic attention compared to scleractinian (stony) corals. Identification of octocoral species is often difficult and ambiguous, and requires thorough microscopic examination of skeletal components (sclerites). Here, we provide a key for field identification—no microscope required—of 51 zooxanthellate (harboring photosynthetic dinoflagellate symbionts) octocoral species (3 soft and 48 gorgonian octocorals) from the tropical western Atlantic. The key is based on characters from colony branching pattern, surface morphology and texture, extended polyp size, and colony color. Although species confirmation by microscopic examination is still recommended, it is hoped that tools, such as this key, and approaches for fast octocoral identification will ease the difficulty of carrying out surveys and monitoring programs.

KEYWORDS.—Octocorals, symbiotic, zooxanthellae, coral reefs, Caribbean, gorgonians, soft corals, identification keys

INTRODUCTION

The underwater landscape of many Caribbean coral reef environments is dominated by zooxanthellate (harboring photosynthetic dinoflagelate symbionts) octocorals (Octocorallia: Cnidaria), commonly referred to as "gorgonians" and "soft corals". Gorgonian is a common name derived from the now controversial ordinal classification Gorgonacea, and is used to loosely categorize octocorals which contain some form of branching morphology with a supporting internal axis of fused sclerites, scleroprotein (gorgonin), or non-scleritic calcium carbonate (Grasshoff and Bargibant 2001). Other octocorals, those which do not contain a supporting internal axis or skeleton and are united in a common fleshy mass, are referred to as soft corals (Fabricius and Alderslade 2001). Scleractinian and soft corals dominate Indo-Pacific reefs (Fabricius and Alderslade 2001) whereas gorgonian octocorals are the most prominent anthozoan found on tropical western Atlantic reefs. Unlike in the Indo-Pacific, most tropical western Atlantic gorgonian species harbor algal symbionts. Though Eastern Pacific reefs and littoral zones are also dominated by gorgonian octocorals including Caribbean congeners, only the counterparts present in the Atlantic host symbionts (e.g., *Muricea*). In a typical Southern Caribbean coral reef such as the fringing system in the vicinity of Bocas del Toro, Panama, only 7 (11%) out of 61 species of octocorals found do not host symbionts (see Appendix). Although gorgonian octocorals are susceptible to diseases (e.g., Smith et al. 1996), Caribbean gorgonians seem to be very resistant to coral bleaching or expulsion of their symbionts (Lasker 2003; Lewis and Coffroth 2004), which will likely have an impact on reef community structure where scleractinian corals are more susceptible to bleaching related mortality. Despite their abundance and ecological importance, however, octocorals have not had comparable research to that of scleractinian corals. A reason for this may be the extreme difficulty in differentiating gorgonian groups and species, which often requires thorough microscopic examinations of sclerites and axis (e.g., Bayer 1961).

Since species familiarization and surveys are the base for further research, it is essential to develop tools, keys, and approaches for fast octocoral identification. In addition, as new species of octocorals are described annually, and scanning electron microscopy (SEM) is becoming the dominant method to morphologically describe octocorals, the complete microscopic examination of octocoral traits for ecological or other rapid surveys will require unrealistic amounts of resources and effort. Consequently, it is important to develop tools for fast and accurate identification of octocoral fauna.

Field surveys, photography-collection, and microscopic examination are the most reliable approaches to become familiar with octocoral species. Here, we provide a means to identify octocorals based entirely on field-observable characteristics. A complementary analysis of underwater observations and microscopic examinations of octocoral sclerites has made it possible to develop a set of keys to accurately identify gorgonian octocorals in their habitat. During the 2003-Invertebrate Workshop (Smithsonian Institution, Bocas del Toro, Panama) preliminary ideas and notes on a field key for the identification of Caribbean zooxanthellate octocorals were tested through direct observations, digital photography, and microscopic examinations. Our observations are not limited to Panama and include surveys from southeastern Florida, Puerto Rico, Bahamas, México, Belize, Tobago and Colombia, which give us an ample model of the variation found within the tropical western Atlantic. The keys were designed for the identification, without colony collection or microscopic examination of sclerites, of most zooxanthellate octocorals common to the region. They are based on the combination of several characters: colony branching pattern, surface morphology and texture, extended polyp size and color, and colony color. Color was used only when no other external character was available to differentiate among species. When ever size was used in the keys, it refers to a relative comparison to the next closest species. Therefore, it is important that dubious identifications be confirmed with microscopic examination of sclerites. Finally, these keys are not intended to be exact, exhaustive or exclusive, but to provide a means to quickly and accurately identify octocoral colonies in the field.

As with the analysis of any group, it is unavoidable to use specialized terminology to describe particular traits. The use of terminology was minimized as much as possible and the few used terms are described in detail in Table 1. Sources of terminology on gorgonian traits were extracted and/or modified from Bayer (1961), Cairns (1977) and Bayer et al. (1983). Additional information and concepts on external features and branching patterns of Caribbean gorgonian octocorals are found in Sánchez and Lasker (2003) and Sánchez et al. (2004).

Key to Zooxanthellate octocorals of the tropical western Atlantic

1a. Colonies with no axis, encrusting or single branches rising from a base: Soft corals ---------- 2

1b. Colonies with an axis, not encrusting; branching dichotomous, pinnate, bushy, or candelabral: ------- 4

2a. Coenenchyme purplish with shades of gray or tan; apertures open, encrusting or branching; polyps dark and large (> 1 cm): ---------- 3

2b. Coenenchyme beige; polyps light and small (< 1 cm): ---------- ---------- *Erythropodium caribaeorum* (Duchassaing & Michelotti) (Fig. 1 A)

3a. Colonies with rod-like branching, usually connected by a stolonal mat: ---- ---------- *Briareum asbestinum* (Pallas) (Fig. 1 B)

3b. Colonies encrusting forming soft meat-ball like lobes; usually encrusting gorgonian corals: ---------- ------ *Briareum polyanthes* (Duchassaing & Michelotti) (Fig. 1 C)

4a. Colonies with pinnate branches, anastomosing, or plume-like with flattened branchlets, never round or

TABLE 1. Definitions of terms used in the keys.

Anastomosing	Condition in which the branches of a colony fuse to form a meshed pattern.
Aperture	Opening of the calyx into which the polyp retracts.
Ascending	Description of upward growing branches that are usually long and directed vertically.
Axis	Inner supporting structure of holaxonian gorgonians.
Branch axils	Junction where two branches come together.
Branchlets	Branches that arise from other branches, daughter branches, usually located terminally and smaller than the rest.
Bushy	Colonies with abundant branching not forming an obvious pattern.
Calyx, Calyces	Casing in which the polyp sits; may or may not be present as projections from colony surface.
Candelabral (candelabrum)	Branching pattern in which the colony is flattened in one plane.
Clavate	Branch tip ending in a rounded lobe.
Clonal	Asexually propagating colony by stolons or fragments.
Coenenchyme	Tissue between the polyps.
Cross-section	Cut through a branch at right angles to the longest axis.
Dichotomous	Branching pattern consisting of repeated bifurcations.
Encrusting	Growth form in which the colony takes the shape of the surface on which it grows.
Fan-shaped	Flattened colony shape with branches packed closely together.
Gaping	Referring to an aperture that is conspicuously open.
Lateral branching	Colony growth in which branching originates as irregular or alternate side daughter branches.
Pinnate	Feather-like branching pattern which consists of a primary branch with secondary branches emerging on either side of mother branch.
Pinnules	Lateral branchlets in pinnate branching.
Plume, Plumose	Branching pattern that resembles a feather, usually long and flowing.
Polyp	An individual of the colony, emerging from the calyx aperture and bearing tentacles.
Ramifications	Referring to whether branches have other branches emerging from them.
Shrubby	Description of colony that is short with most of its growth occurring laterally.
Stolon	A part of a colony that grows horizontally on the substrate, from which new upright branches arise.
Tapering	Referring to branches that become gradually smaller at their ends.

rod-like; calyces generally along either side of branch, never uniformly around the branch; or bushy colonies with thin branches flattened or triangular in cross-section: ---------- "gorgoniid" gorgonians* [A]

*(Most genera in this group belong to the family Gorgoniidae minus *Pterogorgia*, whose phylogenetic placement is uncertain.)

4b. Colonies candelabral, bushy or pinnate; branches rod-like, circular in cross-section ranging from short and stubby to long and ascending: ---------- "plexaurid" gorgonians* [B]

*(Most genera in this group belong to the family Plexauridae minus *Plexaurella*, a likely gorgoniid, and *Muriceopsis*, whose phylogenetic placement is uncertain.)

[A] Key to the "gorgoniid" gorgonians

1a. Colonies with branches interconnected, forming a net-like fan: ---------- *Gorgonia* spp. (AI)

1b. Colonies with pinnate branches in the form of a plume, or bushy colonies whose branches are flat or triangular in cross-section: ---------- 2

2a. Colonies bushy with extremely flattened tape-like branches or sometimes triangular in cross-section; polyps white: ---------- *Pterogorgia* spp. (AII)

2b. Colonies with pinnate branching (pinnules), forming plumes; polyps brown or golden: ---------- *Pseudopterogorgia* spp. (AIII)

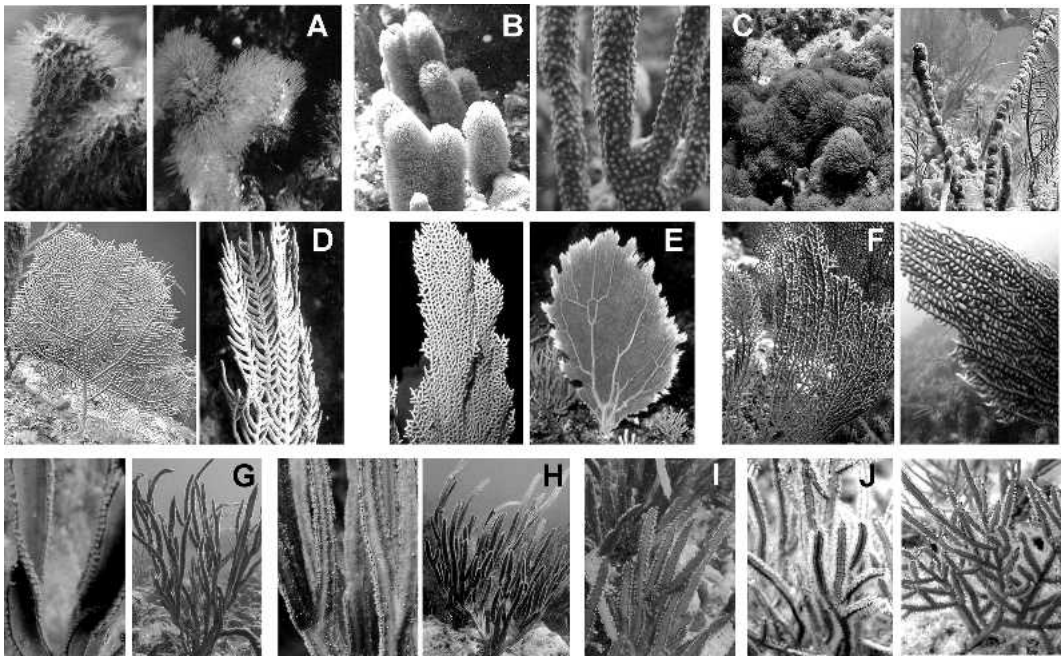

FIG. 1. A. *Erytropodium caribaeorum* (Bocas del Toro-BT, Panama, B. *Briareum asbestinum* (Serrana Bank, Colombia), C. *B. polyantes* (BT, Panama; Eleuthera I., Bahamas), D. *Gorgonia mariae* (Belize; BT, Panama), E. *G. ventalina* (Uraba, Colombia), F. *G. flabellum* (Belize; BT, Panama), G. *Pterogorgia anceps* (BT, Panama), H. *P. guadalupensis* (BT, Panama), I. *Pterogorgia* sp. (BT, Panama), J. *P. citrina* (Quitasueño, bank). (Photos J. A. Sánchez).

[AI] *Gorgonia*

1a. Colonies with a tightly anastomosing mesh; mesh square: ---------- 2
1b. Colonies with branches partially pinnate and reticulate (may be mostly pinnate or mostly reticulate), mesh wider than longer: ---------- *Gorgonia mariae* Bayer (Fig. 1 D)
2a. Colonies with round branches, or slightly flattened in the plane of the fan: ---------- *Gorgonia ventalina* Linnaeus (Fig. 1 E)
2b. Colonies with robust branches and coenenchyme flattened at opposite angles to the fan's surface: ---------- *Gorgonia flabellum* Linnaeus (Fig. 1 F)

[AII] *Pterogorgia*

1a. Cross-section of branches flat, from base to tip: ---------- 2
1b. Cross section of branch base with 3 or 4 flaps which appear triangular or boxed in cross-section; branch tips long, thin, and flattened; ---------- *Pterogorgia anceps* (Pallas) (Fig. 1 G)
2a. Colonies usually tall and heavily branched; blades broad and flat: ---------- *Pterogorgia guadalupensis* (Duchassaing & Michelotti) (Fig. 1 H)
2b. Colonies small, usually less than 20 cm; blades narrow: ---------- 3
3a. Colonies sparsely branched, with ascending branch tips; polyps arise from a common groove: ---------- *Pterogorgia* sp. (Fig. 1 I)
3b. Colonies bushy with branching in multiple directions; polyps arise from individual calyces, not a common groove: ---------- *Pterogorgia citrina* (Esper) (Fig. 1 J)

[AIII] *Pseudopterogorgia*

1a. Colony surface slimy when touched: ---------- 2

1b. Colony surface not slimy, coarse when touched: ---------- 3
2a. Colonies tall with long, regularly branching pinnules; extremely slimy and full of mucus when alive; branchlets mat together when dry: ---------- *Pseudopterogorgia americana* (Gmelin) (Fig. 2A)
2b. Colonies less than 1 meter with short and irregular pinnules, moderately slimy with no mucus; branchlets do not mat when dry: ---------- *Pseudopterogorgia elisabethae* Bayer (Fig. 2B)
3a. Pinnules short and thin, paired on either side of main branch and spaced at regular intervals (similar to *P. elisabethae* but pinnules thinner, more closely spaced and always paired): ---------- *Pseudopterogorgia bipinnata* (Verrill) (Fig. 2C)
3b. Pinnules longer and wider, not paired or placed at regular intervals, but closer together and tapering: ---------- 4
4a. Branches flat, remain separated when dry; polyps regularly placed along branch edge; multiple stems (large colonies similar in form to *P. americana* but not slimy): ---------- *Pseudopterogorgia acerosa* (Pallas) (Fig. 2D)
4b. Branches long; polyps mostly irregularly placed along branch edge; usually one main stem: ---------- *Pseudopterogorgia rigida* (Bielschowsky) (Fig. 2E)

[B] Key to the "plexaurid" gorgonians

1a. Apertures slit-like; if apertures oval, gaping or pore-like, branching obviously dichotomous; pale baige to yellow: ---------- *Plexaurella* spp. (BI)
1b: Branching never dichotomous; apertures round or oval, sometimes obscured by upturned lower lip: --- 2
2a. Branches slimy; calyces never raised or rough to touch; apertures round or oval, sometimes gaping with slightly raised rims on terminal

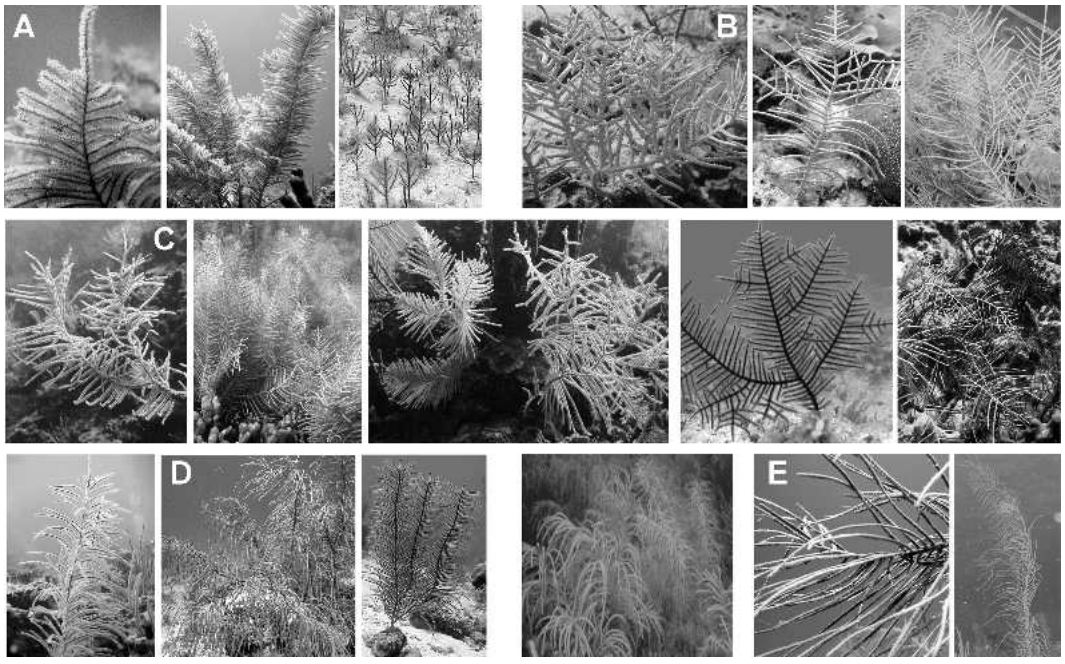

FIG. 2. A. *Pseudopterogorgia americana* (Serrana Bank, Colombia), B. *P. elisabethae* (Roncador Bank, Colombia), C. *P. bipinnata* (Belize), D. *P. acerosa* (San Salvador, Bahamas), E. *P. rigida* (Belize). (Photos J. A. Sánchez).

branches; lower calycular lip never present:---------- BII

2b. Branches not slimy; calyces ranging from flat to prominent, sometimes rough and spiny; lower calycular lip always present at least as a weak shelf:---------- 3

3a. Colonies pinnate or plumose: ------ 4

3b. Colonies bushy, candelabral, or with ascending branches: ---------- 5

4a. Calyces prominent, rough and spiny: ---------- *Muricea pinnata* Bayer (Fig. 4 A)

4b. Calyces at most slightly raised with a weak shelf-like calycular lip: ----- ---------- *Muriceopsis* spp. (BIII)

5a. Calyces prominent, rough and spiny; color usually yellow-green, white or orange: ---------- *Muricea* spp. (BIV)

5b. Calyces almost flat to tubular or with lower lip, never rough and spiny; color pale to dark brown, grey, pink or purple: ---------- ----- *Eunicea* spp. & *Plexaura* spp. (BV)

[BI] *Plexaurella* spp.

1a. Colonies with thick branches; slit-like apertures:---------- 2

1b. Colonies bushy with thinner branches coming from the base; apertures oval, pore-like:---------- 4

2a. Branches long and conspicuously thick with sparse branching; not bushy, usually tall; calyces form hemispherical mounds: ---------- -------- *Plexaurella nutans* (Duchassaing & Michelotti) (Fig. 3 A)

2b. Colonies shrubby with short branches ranging from moderately stout to stout; calyces highly conspicuous to flat; polyps short when extended: ---- 3

3a. Colonies bushy, branching from the base; calyces slightly elevated to smooth; branches thin and long: --- ---- *Plexaurella fusifera* Kunze (Fig. 3 B)

3b. Colonies with moderate branching, branching dichotomous; calyces usually form hemispherical

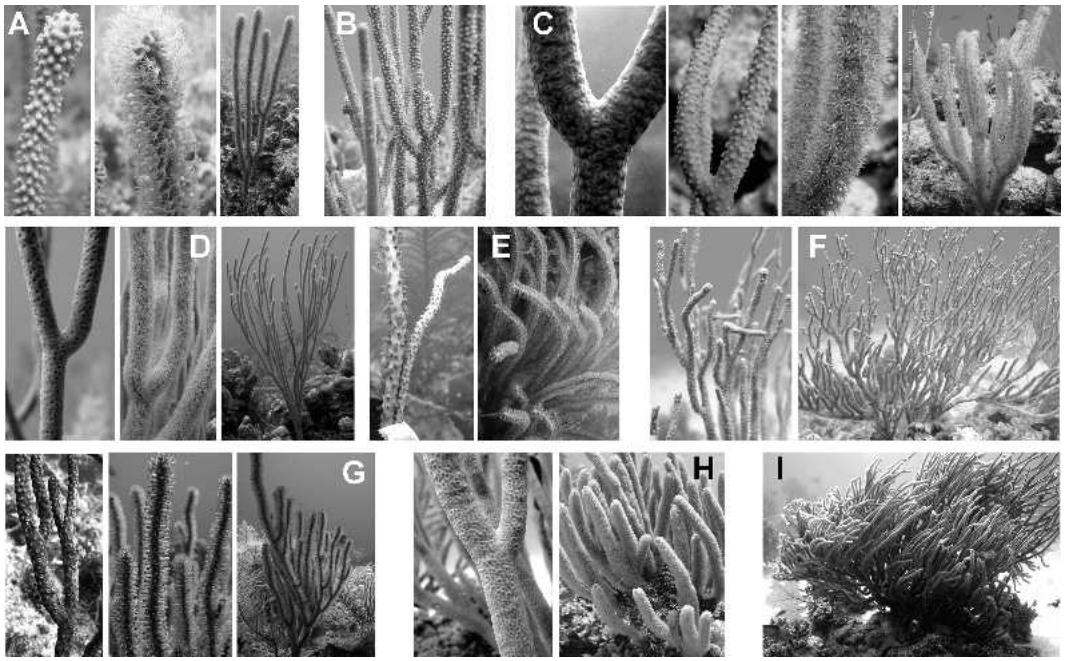

FIG. 3. A. *Plexaurella nutans* (BT, Panama), B. *P. fusilera* (BT, Panama), C. *P. dichotoma* (Belize), D. *P. grisea* (BT, Panama), E. *Plexaurella* sp. (BT, Panama), F. *Plexaura kuna* (Belize), G. *Eunicea knighti* (Belize), H. *Pseudoplexaura porosa* (Quitasueño Bank, Colombia), I. *P. crucis* (Serrana bank, Colombia). (Photos J. A. Sánchez).

mounds; branches somewhat robust: ---------- *Plexaurella dichotoma* (Esper) (Fig. 3 C)

4a. Coarse and firm branches: ---------- *Plexaurella grisea* Kunze (Fig. 3 D)

4b. Flexible and slimy branches: ---------- *Plexaurella* sp. (Fig. 3 E)

[BII]

1a. Branches long and ascending: ---------- 2

1b. Branches short and profusely ramified: ---------- *Plexaura kuna* Lasker, Kim & Coffroth (Fig. 3 F)

2a. Bulb or knob at some or all of the branch tips, sometimes present on the branches or branch axils; polyp tentacles darker than polyp body; colonies reddish brown: ---------- *Eunicea knighti* Bayer (Fig. 3 G)

2b. Conspicuous knobs never present at branch tips; extended polyps uniform in color; colonies purple, ocher, greenish-yellow, or light olive gray-brown: ---------- 3

3a. Polyp apertures dark and conspicuous; branches thick: ---------- *Pseudoplexaura porosa* (Houttuyn) (Fig. 3 H)

3b. Polyp apertures small; branches thin: ---------- 4

4a. Outer coenenchyme particularly greenish-yellow; colonies short but profusely branched: ---------- *Pseudoplexaura crucis* Bayer (Fig. 3 I)

4b. Outer coenenchyme beige to pale purple; colonies tall with long, slender tapering branches: ---------- *Pseudoplexaura flagellosa* (Houttuyn) & *Pseudoplexaura wagenarii* (Stiasny).*

*(These two species can only be distinguished by microscopic examination.)

[BIII] *Muriceopsis* spp.

1a. Colonies tall; branches thin; branching pinnate: ---------- 2

1b. Colonies short (<20 cm) and bushy; branches robust: ---------- *Muriceopsis bayeriana* Sánchez (Fig. 4 F)

2a. Branching uniformly pinnate; branch pinnules short and firm; found throughout the reef: ---------- *Muriceopsis flavida* (Lamarck) (Fig. 4 G)

2b. Branching not entirely pinnate; branches long and flexible; found only on reef slope: ---------- *Muriceopsis petila* Bayer (Fig. 4 H)

[BIV] *Muricea* spp.

1a. Branches robust, flattened and elliptical in cross section: ---------- 2

1b. Branches thin and delicate, cylindrical in cross section: ---------- *Muricea laxa* Verrill (Fig. 4 B)

2a. Colonies bushy; branches elongate and ascending with thin tips: ---------- *Muricea elongata* Lamouroux (Fig. 4 C)

2b. Colonies candelabral, tending to branch in one plane; branchlets short, never elongate; branches thick to the tip: ---------- 3

3a. Colonies yellowish, orange or amber; branch axils conspicuously flattened; branches tightly compacted: ---------- *Muricea muricata* (Pallas) (Fig. 4 D)

3b. Colonies white to grey; branch axils not conspicuously flattened; branching open: ---------- *Muricea atlantica* (Kükenthal) (Fig. 4 E)

[BV] *Eunicea* spp. & *Plexaura* spp.

1a. Calyces elongate, tubular or conical; lower lip alone may be slightly upturned, but never with a conspicuous sharp upper lip:---------- 2

1b. Calyces never tubular or conical, present as an upturned lip, bump, or hemispherical in shape:---------- 5

2a. Branches thin, usually single branches rising from the base; calyces longer than branch diameter: ---------- *Eunicea laxispica* (Lamarck) (Fig. 5 A)

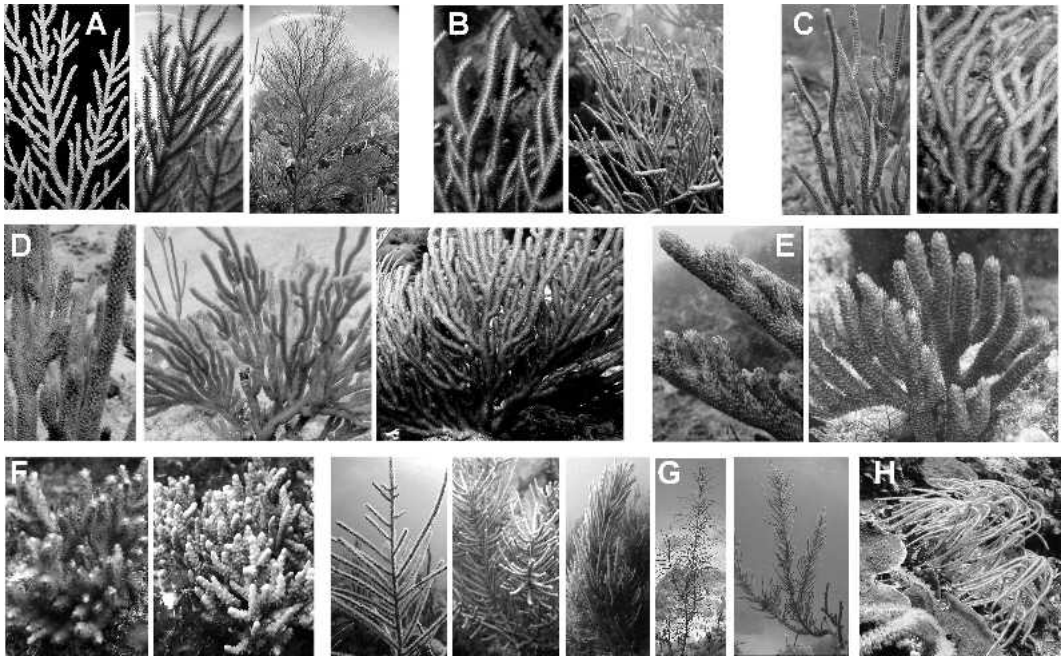

FIG. 4. A. *Muricea pinnata* (Lee Stocking Island, Bahamas), B. *M. laxa* (BT, Panama), C. *M. elongate* (BT, Panama), D. *M. muricata* (Belize), E. *M. atlantica* (BT, Panama), F. *Muriceopsis bayeriana* (BT, Panama), G. *M. flavida* (Lee Stocking Island, Bahamas), H. *M. petila* (Belize). (Photos J. A. Sánchez).

2b. Branches thicker, calyces not longer than branch diameter:---------- 3

3a. Colonies candelabral with a tendency to be bushy; some or most calyces with a slightly upturned lower lip; branch axils thick; color light yellowish brown: ---------- *Eunicea mammosa* Lamouroux (Fig. 5 B)

3b. Colonies ascending; branch axils not noticeable; coenenchyme dark to almost black:---------- 4

4a. Branches long and thick; coenenchyme dark with pale to white conspicuously tubular calyces: ---------- *Eunicea* sp. 1 (Fig. 5 C-D)

4b. Branches long and thin; calyces and branches usually same dark color; most calyces conical, some may be mound-like: ---------- *Eunicea clavigera* Bayer (Fig. 5 E)

5a. Colonies candelabral or with a tendency to branch in one plane; branches stout or moderately thick and elongate; if branches thin calyces hemispherical: ---------- 6

5b. Colonies bushy or tall; branches ascending; if branching in one plane, branches thin and calyces inconspicuous, never hemispherical:----- 7

6a. Calyces hemispherical with upturned lower lip; colonies medium to light brown, branches never stout: ---------- *Eunicea succinea* (Pallas) (Fig. 5 F)

6b. Calyces with conspicuous upturned lower lip that is not hemispherical and tends to be pointed; apertures may be gaping:---------- 8

7a. Colonies bushy, from short and shrubby to broad, tall and flat; branches thin:---------- 9

7b. Colonies ascending, never broad or flattened; branches thick: ---------- 10

8a. Colonies dark brown; compressed branches elliptical in cross section; apertures small with a projecting lower lip; diameter of branch-ends same or smaller than branch; never clonal: ---------- *Eunicea tourneforti* Milne Edwards & Haime (Fig. 5 G)

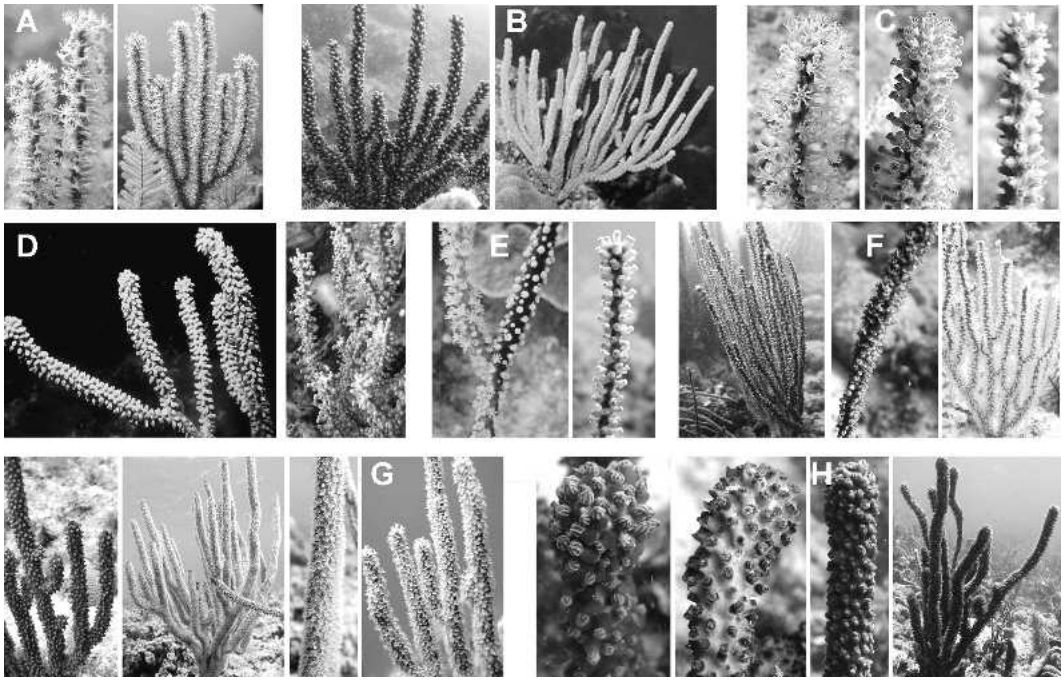

FIG. 5. A. *Eunicea laxispica* (Abaco, Bahamas), B. *E. mammosa* (Roncador bank, Colombia), C. *E. colombiana* (San Salvador, Bahamas), D. *E.* sp. 1 (Fuerte I., Colombia), E. *E. clavigera* (BT, Panama), F. *E. succinea* (BT, Panama), G. *E. tourneforti* (Serrana Bank, Colombia), H. *E. laciniata* (BT, Panama). (Photos J. A. Sánchez).

8b. Colonies medium brown; branches cylindrical and usually stout; apertures with eight surrounding lobules and larger projecting lower lip tip; branch ends usually bulbous and clavate; branching may be horizontal, appearing to rise from a stolon and highly clonal: -------- ---------- *Eunicea laciniata* Duchassaing & Michelotti (Fig. 5 H)

9a. Colonies with elongate, straggling branches; calyces conspicuous with regularly placed upturned lower lips giving a rugged texture: ------- ---------- *Eunicea* sp. 2 (Fig. 6 C)

9b. Colonies with flat calyces or present as a slight lip or mound: ----- 11

10a. Color dark; calyces with upturned lower lip usually giving a coarse texture: ---------- ------- *Eunicea asperula* Milne Edwards & Haime (Fig. 6 A)

10b. Color variable from light to dark; calyces flat or mound-like; apertures with ridges on inner lip, they may appear sealed or gaping: ---- ---------- *Eunicea calyculata* Ellis & Solander (Fig. 6 B)

11a. Calyces present as an inconspicuous lip or not at all; branches brittle; colonies bushy with prominent lateral branching---------- 12

11b. Colonies pale, medium to light browns, or purple, never black; true calyces may be present: ------ 13

12a. Colonies dark brown to black; ---- ---------- *Plexaura homomalla* (Esper) (Fig. 6 D)

12b. Colonies lavender to pale grey; ---- ---------- *Plexaura kuekenthali* Moser (Fig. 6 E)

13a. Colonies broad, usually tending to be in one plane; branching usually profuse; calyces absent or present as a lower lip, apertures small (pinhole in appearence): ---------- ---------- *Eunicea flexuosa* (Lamouroux) (Fig. 6 F)

13b. Colonies bushy, but never flattened with tendency to be in one

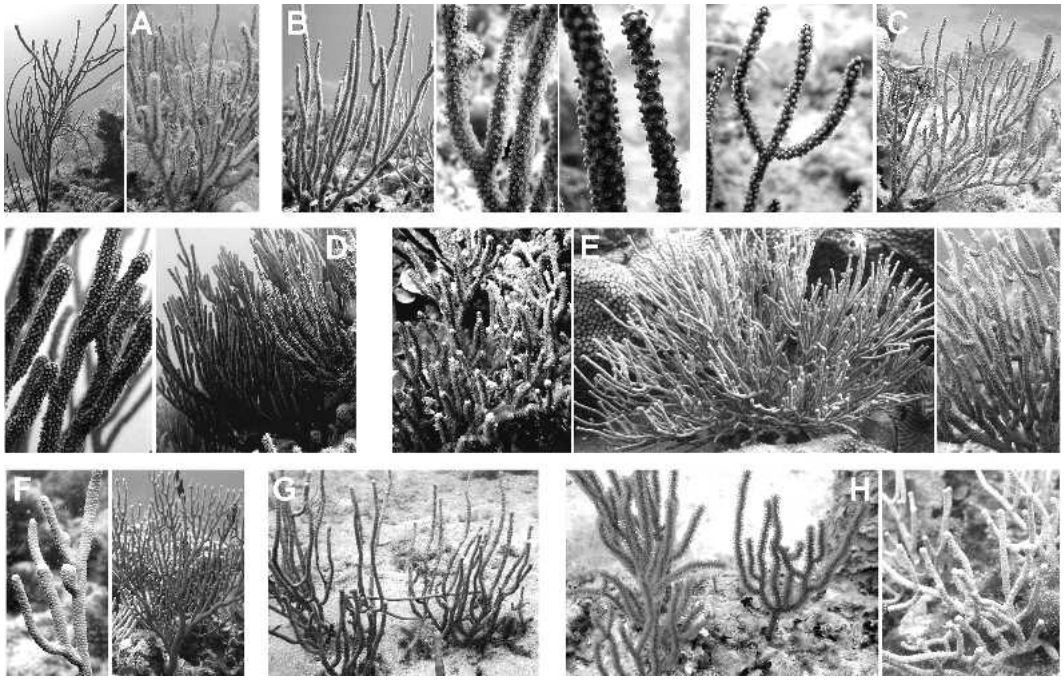

FIG. 6. A. *Eunicea asperula* (Belice; BT, Panama), B. *E. calyculata* (Roncador bank, Colombia), C. *E.* sp. 2 (San Salvador, Bahamas), D. *Plexaura homomalla* (Quitasueño Bank, Colombia), E. *P. kukenthali* (BT, Panama), F. *Eunicea flexuosa* (Belize), G. *E. pallida* (BT, Panama), H. *E. fusca* (BT, Panama). (Photos J. A. Sánchez).

plane; apertures clearly observable: ---------- 14
14a. Colonies nearly white: ---------- 15
14b. Colonies not nearly white: --------- 16
15a. Colonies small, few ramifications; branches brittle; occasionally clonal: ---------- *Eunicea pallida* Garcia-Parrado and Alcolado (Fig. 6 G)
15b. Colonies tall, profusely branched; branches flexible: ---------- *Eunicea pinta* Bayer and Deichmann
16a. Colonies usually small and rather bushy; terminal branches thin; calyces small and irregular in appearance; often clonal: ---------- *Eunicea fusca* Duchassaing and Michelotti (Fig. 6 H)
16b. Colonies bushy, but more flattened or candelabral; color usually light browns or beige, sometimes with hints of lavender or purple; apertures may be slightly gaping and regularly placed; calyces sometimes smooth or present as lower lip: ---------- *Eunicea palmeri* Bayer

DISCUSSION

Most tropical western Atlantic zooxanthellate gorgonian octocorals are closely related phylogenetically (Sánchez et al. 2003; Wirshing et al. 2005), and comprise a highly endemic fauna. Consequently, most taxa have sister species with similar morphological characters, which makes it, in some cases, extremely difficult to differentiate species without thorough microscopic examination. In addition, most species are morphologically plastic and exhibit extensive variation both within habitats and over environmental gradients. This makes most observable traits a potential source of confusion among species. In spite of this, it is possible, after familiarization with the organisms, to identify tropical western Atlantic gorgonians macroscopically. It is recommended that identifiers unfamiliar with

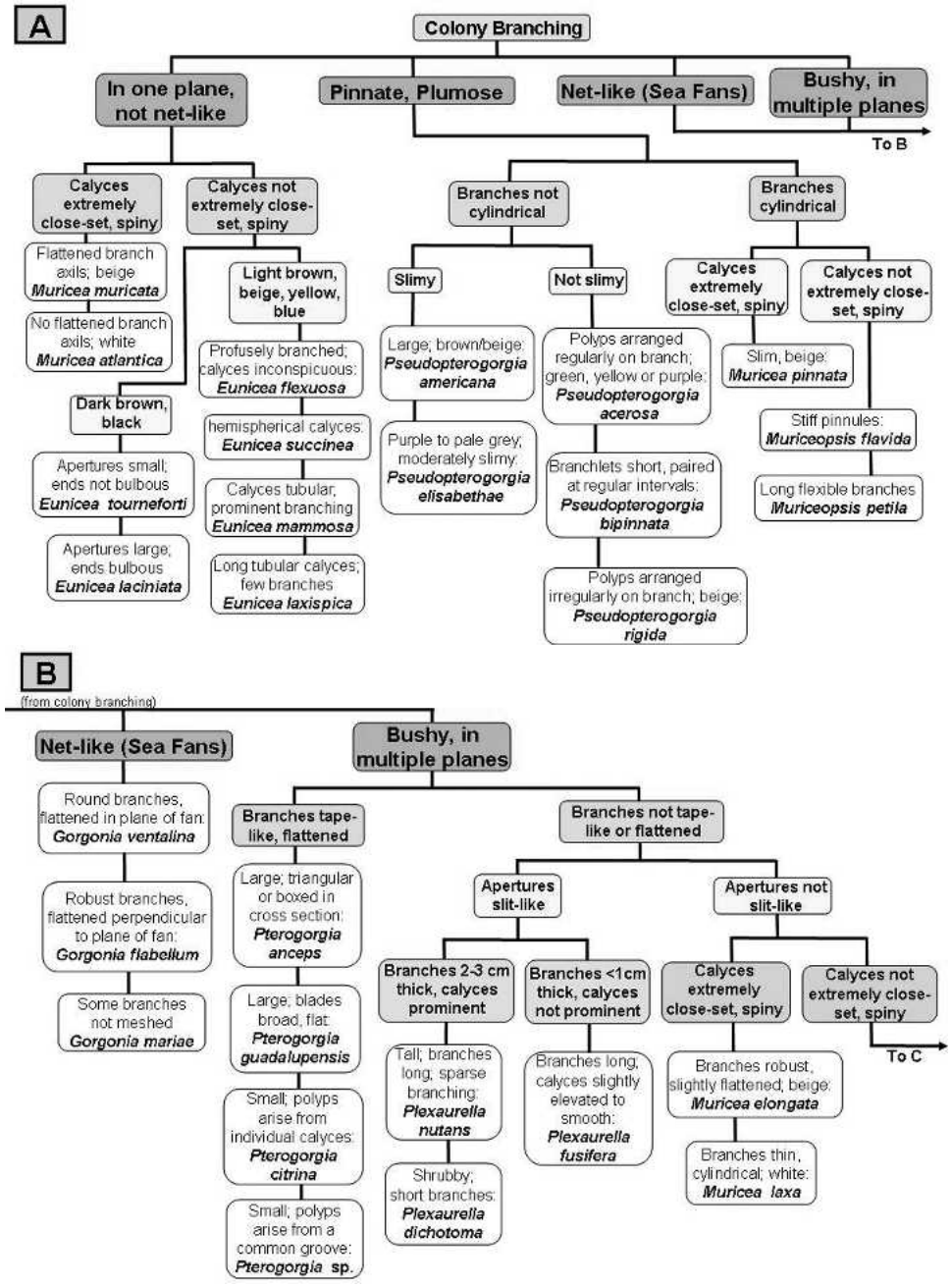

FIG. 7. Flow chart diagram for fast visual identification of Caribbean symbiotic gorgonian corals (Octocorallia: Cnidaria).

gorgonian taxonomy confirm macroscopic identifications with microscopic analysis until a foundation is established on which to confidently differentiate species macroscopically. Microscopic confirmations provide excellent feedback and reinforce the identifier's confidence in macroscopic field identifications. Most species should be-

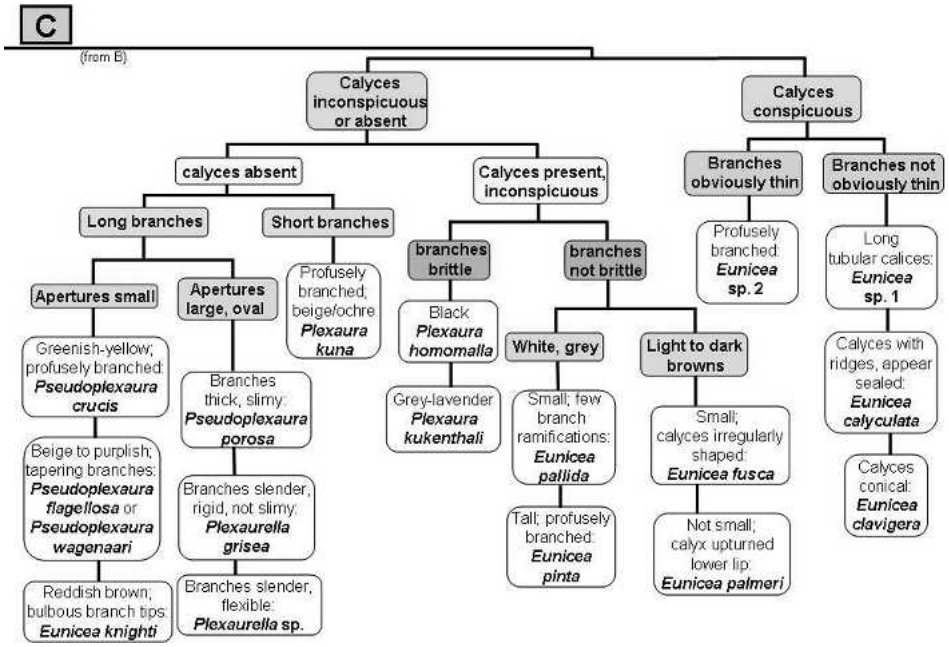

FIG. 7. Continued

come readily distinguishable in the field, and any dubious identification narrowed to two or three species which could then be verified by a minimal amount of microscopic examination. Figure 7 illustrates a scheme of how the keys may be adapted into a flow chart based on basic morphological characters. The chart follows a simple dichotomous pattern based on the presence or absence of a character, and ends with a cluster of individual species each differentiated by a brief diagnostic description. Although it may be an oversimplification, Fig. 7 can be used as a rapid underwater guide. Bayer (1961) is still the most comprehensive source of keys and morphological information for microscopic identifications of tropical western Atlantic gorgonians. In addition, several new species of *Muriceopsis* and *Eunicea* were recently distinguished (Sánchez 2001 and unpublished), and provide further details on particular characters.

Convergent evolution in morphological traits appears to be a recurrent pattern in the evolution of Caribbean gorgonian corals (Sánchez 2004; Wirshing et al. 2005). Convergence is recognized in many observable traits like branching pattern (e.g., *Muriceopsis* and *Pseudopterogorgia* with pinnate branching), calyx morphology (e.g., *Plexaurella grisea* and *Psuedoplexaura* spp. with flat calyces), surface texture (e.g., *Plexaura kuna* and *Pseudoplexaura crucis* with a slimy texture) and color among others. Therefore, it is important to recognize that these are artificial keys to species level, and not a taxonomic or systematic review based on morphological similarities. However, the keys do attempt to follow taxonomic lines. They loosely group most members of the family Plexauridae, key [A], and Gorgoniidae, key [B], together. Although each family may seem easily distinguishable by their overall appearance, they do not have a truly independent evolutionary origin, but are largely para—and polyphyletic (Sánchez et al. 2003; Wirshing et al. 2005). *Muriceopsis*-a plexaurid—and *Pterogorgia*-a gorgoniid—do not show a phylogenetic relationship with their respective families, and *Plexaurella*-a plexaurid-shares a close phylogenetic relationship with the Gorgoniidae. Therefore, we placed "plexaurids" and "gorgoniids" in quotes in the keys. Most genera key out into separate individual

keys. Key [BII], however, is a mixture of species from three genera (*Plexaura, Pseudoplexaura* and *Eunicea*). *Eunicea* spp. and *Plexaura* spp. were combined in key [BV] because there are no conspicuous macroscopic characters with which to separate them, and *Muricea pinnata* keys out early in key [A] because of its pinnate branching which is unlike the other *Muricea* spp.

Several species of the gorgoniid genus *Pseudopterogorgia* have not been included in the keys because specimens were not yet available. Although many Caribbean *Pseudopterogorgia* were included in the first comprehensive compendium of the tropical western Atlantic (Bayer 1961), they have rarely been seen in shallow-water gorgonian surveys thereafter (e.g., Jordán 1989; Yoshioka and Yoshioka 1991; Sánchez et al. 1997). According to further sclerite analyses, *Pseudopterogorgia rigida* and *P. blanquillensis* as well as *P. elisabethae* and *P. albatrossae* appear to be the same species, with the latter in each group corresponding an ecological morphotype of the former. *Pseudopterogorgia hystrix, P. navia* and *P. hummelincki*, though they have been observed in several surveys, are also morphologically plastic but are extremely rare compared to the abundance of *P. americana, P. bipinnata. P. acerosa, P. elisabethae* and *P. rigida*. Alternatively, the *Eunicea*, are comprised of 16 common species, and are likely the most diverse group of zooxanthellate gorgonians found in the tropical western Atlantic.

Plexaurella dichotoma and *P. fusifera* have nearly identical sclerites with overlapping variation, which has been used as a criterion for synonimizing the two species (Alcolado 1985). We decided to keep the two species based entirely on external features. For instance, it is common to see very thick and clavate colonies of *P. dichotoma* along side long and stiff colonies of what is probably *P. fusifera*. However, it is unknown if the thin, *P. grisea*-like colonies with polyp apertures like slits definitely belong to *P. fusifera*, or to another species. This is a case where a taxonomic revision, preferably corroborated with independent characters (e.g., DNA sequences), is greatly needed. Finally, this paper is meant to be a tool to more easily approach and familiarize oneself with zooxanthellate gorgonian octocorals even though the possibility exists that all of the species included may have cryptic sibling species yet to be discovered.

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LITERATURE CITED

Alcolado, P. M. 1985. Sinonimia de *Plexaura fusifera* Kunze, 1916, con *P. dichotoma* (Esper, 1791) (Coelenterata: Gorgonacea). *Poeyana* 294:1-3.

Bayer, F. M. 1961. The shallow water Octocorallia of the West Indian region. *Stud. Fauna Curaçao* 12:1-373.

Bayer, F. M., M. Grasshoff, and J. Verseveldt. 1983. *An illustrated trilingual glossary of morphological and anatomical terms applied to Octocorallia*, Leiden: E.J. Brill.

Cairns, S. 1977. *Guide to the Commoner Shallow-Water Gorgonians (Sea Whips, Sea Feathers, and Sea Fans) of Florida, The Gulf of Mexico, and the Caribbean Region*. University of Miami Sea Grant Program.

Fabricius, K., and P. Alderslade. 2001. *Soft corals and sea fans: a comprehensive guide to the tropical shallow water genera of the central-west Pacific Ocean and the Indian Ocean and Red Sea*. Melbourne: New Litho.

Grasshoff, M., and G. Bargibant. 2001. *Coral reef gorgonians of New Caledonia*. Faune et Flore Tropicales, number 38.

Jordán, E. 1989. Gorgonian community structure and reef zonation patterns of Yucatán coral reefs. *Bull. Mar. Sci.* 45:670-696.

Lasker, H. R. 2003. Zooxanthella densities within a Caribbean octocoral during bleaching and non-bleaching years. *Coral Reefs* 22(1):23-26.

Lewis, C. L., and M. A. Coffroth. 2004. The acquisition of exogenous algal symbionts by an Octocoral after bleaching. *Science* 304:1490-1492.

Sánchez, J. A. 2001. Systematics of the Southwestern Caribbean *Muriceopsis* Aurivillius (Cnidaria: Octocorallia) with description of a new species. *Bull. Biol. Soc. Wash*. 10:160-180.

Sánchez, J. A. 2004. Evolution and dynamics of branching colonial form in marine modular Cnidarians: Gorgonian Octocorals. *Hydrobiologia* 530 (1):283-290.

Sánchez J. A., and H. R. Lasker. 2003. Patterns of Morphologic Integration in Branching Colonies of Marine Modular Organisms: supra-module organization in Gorgonian Corals. *Proc. Roy. Soc.B -Biol. Sci.* 270:2039-2044. (DOI: 10.1098/rspb.2003.2471)

Sánchez, J. A., J. M. Díaz, and S. Zea 1997. Gorgonian communities in two contrasting nvironments on oceanic atolls of the southwestern Caribbean. *Bull. Mar. Sci.* 61(2):61-72.

Sánchez J. A., C. S. Mcfadden, S. C. France, and H. R. Lasker. 2003. Molecular Phylogenetic analyses of shallow-water Caribbean octocorals. *Mar. Biol*. 142: 975-987.

Sánchez J. A., H. R. Lasker, E. G. Nepomuceno, J. D. Sánchez, and M. J. Woldenberg. 2004. Branching and Self-Organization in Marine Modular Colonial Organisms: a Model. *Am. Nat.* 163(3) (0003-0147/2004/16303-20458). (NEW)

Smith, G., L. D. Ives, I. A. Nagelkerken, and K. B. Ritchie. 1996. Aspergillosis associated with Caribbean sea fan mortalities. *Nature* 382:487.

Wirshing H. H., C. G. Messing, C. J. Douady, J. Reed, M. J. Stanhope, and M. S. Shivji. 2005. Molecular evidence for multiple lineages in the gorgonian family Plexauridae (Anthozoa: Octocorallia). *Mar. Biol.* 147(2):497-508.

Yoshioka, P. M., and B. B. Yoshioka 1991. A comparison of the survivorship and growth of shallow-water gorgonian species of Puerto Rico. *Mar. Ecol. Prog. Ser*. 69:253-260.

APPENDIX

List of 61 octocorals (Anthozoa: Cnidaria) observed in the reefs and sand/rubble slopes in the vicinity of Bocas del Toro, Panama (1-30 m). All species were collected and the identification confirmed through microscopic observations (J. A. Sánchez, Bocas del Toro, Invertebrate Workshop 2003). Voucher specimens are deposited at Bocas del Toro field station (Smithsonian Institution, Panama). Species with a star (*) are aposymbiotic octocorals.

SUBCLASS OCTOCORALLIA HAECKEL, 1866
(=ALCYONARIA) (OCTOCORALS)

Family VIRGULARIIDAE Verrill, 1868
Genus *Stylatula* Verrill, 1864
*Stylatula sp.**
Family TELESTIDAE Milne Edwards & Haime, 1857
Genus *Carijoa* Müller, 1867
Carijoa riisei (Duchassaing & Michelotti, 1860)*
Family BRIAREIDAE Gray, 1859
Genus *Briareum* Blainville, 1830
Briareum asbestinum (Pallas, 1766)
Briareum polyanthes Duchassaing & Michelotti, 1860
Family ANTHOTHELIDAE Broch, 1916
Genus *Erythropodium* Kölliker, 1865
Erythropodium caribaeorum (Duchassaing & Michelotti, 1860)
Family PLEXAURIDAE Gray, 1859
Genus *Plexaura* Lamouroux, 1812
Plexaura homomalla (Esper, 1792)
Plexaura kükenthali Moser, 1921
Plexaura kuna Lasker et al., 1996
Genus *Pseudoplexaura* Wright & Studer, 1889
Pseudoplexaura porosa (Houttuyn, 1772)
Pseudoplexaura flagellosa (Houttuyn, 1772)
Pseudoplexaura wagenaari (Styasny, 1941)
Pseudoplexaura crucis Bayer, 1961
Genus *Eunicea* Lamouroux, 1816
Eunicea mammosa Lamouroux, 1816
Eunicea succinea (Pallas, 1766)
Eunicea laxispica
Eunicea fusca Duchassaing & Michelotti, 1860
Eunicea flexuosa (Lamouroux, 1821)
Eunicea laciniata Duchassaing & Michelotti, 1860
Eunicea tourneforti Milne Edwards & Haime, 1857
Eunicea asperula Milne Edwards & Haime, 1857
Eunicea clavigera Bayer, 1961
Eunicea knighti Bayer, 1961
Eunicea calyculata (Ellis & Solander, 1786)
Eunicea pallida Garcia-Parrado & Alcolado, 1997
Eunicea sp. 1
Eunicea sp. 2
Genus *Muriceopsis* Aurivillius, 1931
Muriceopsis flavida (Lamarck, 1815)
Muriceopsis petila Bayer, 1961
Muriceopsis bayeriana Sánchez, 2001
Genus *Plexaurella* Kölliker, 1865
Plexaurella dichotoma (Esper, 1791)
Plexaurella nutans (Duchassaing & Michelotti, 1860)
Plexaurella fusifera Kunze, 1916
Plexaurella grisea Kunze, 1916
Plexaurella sp.
Genus *Muricea* Lamouroux, 1821
Muricea muricata (Pallas, 1766)
Muricea atlantica Kükenthal, 1919
Muricea laxa Verrill, 1864
Muricea elongata Lamouroux, 1821
Muricea pinnata Bayer, 1961
Family GORGONIIDAE Lamouroux, 1812
Genus *Pseudopterogorgia* Kükenthal, 1919
Pseudopterogorgia bipinnata (Verrill, 1864)
Pseudopterogorgia acerosa (Pallas, 1766)
Pseudopterogorgia elisabethae Bayer, 1961
Pseudopterogorgia americana (Gmelin, 1791)
Pseudopterogorgia rigida (Bielschowsky, 1929)

Pseudopterogorgia hystrix Bayer, 1961
Genus *Gorgonia* Linnaeus, 1758
Gorgonia ventalina Linnaeus, 1758
Gorgonia sp. cf. *flabellum* Linnaeus, 1758
Gorgonia mariae Bayer, 1961
Genus *Pterogorgia* Ehrenberg, 1834
Pterogorgia citrina (Esper, 1792)
Pterogorgia anceps Pallas
Pterogorgia guadalupensis
Pterogorgia sp.
Genus *Lophogorgia* Milne Edwards & Haime, 1857
Leptogorgia sp.*
Lophogorgia punicea (Milne Edwards & Haime, 1857)*
Lophogorgia cardinalis Bayer, 1961*
Genus *Leptogorgia* Milne Edwards & Haime, 1857
Leptogorgia stheno (Bayer, 1952)*
Leptogorgia euryale (Bayer, 1952)*
Leptogorgia medusae (Bayer, 1952)*
Family ELLISELLIDAE Valenciennes
Genus *Ctenocella* Valenciennes, 1955
Subgenus *Ellisella* Gray, 1858
Ctenocella (Ellisella) schmitti (Bayer, 1961)*
Ctenocella (Ellisella) sp. cf. *barbadensis**
Ctenocella (Ellisella) sp.*