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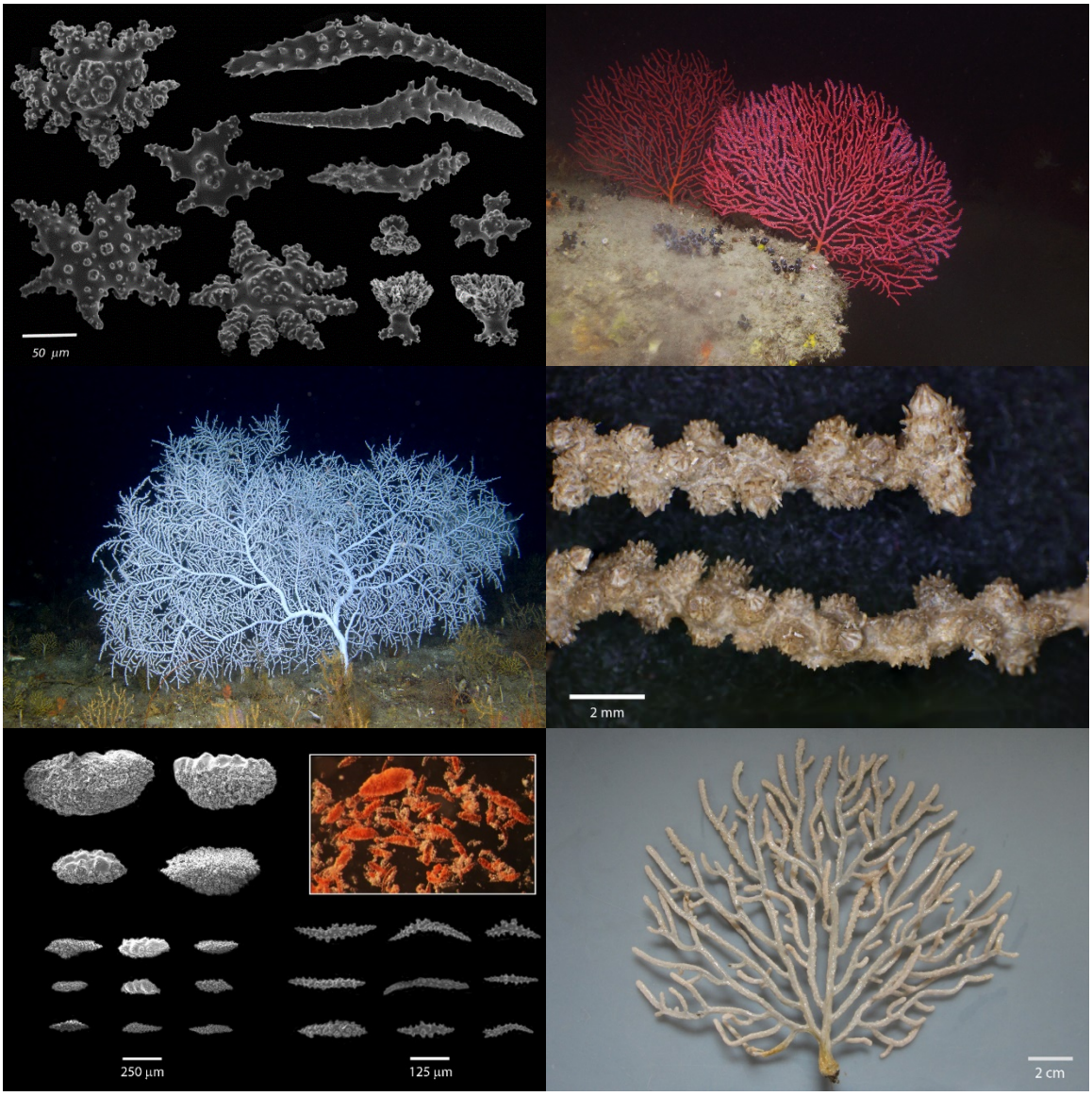
Alcyonacean octocorals of the Pinnacle Trend: A photo-identification guide



NOAA Technical Memorandum NOS NCCOS 282

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Alcyonacean octocorals of the Pinnacle Trend: A photo-identification guide

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Introduction

Octocorals are common components of the deep-water benthic assemblage in the Gulf of Mexico. In rocky habitats they commonly occur as sea fans (Order Alcyonacea). In soft bottom habitats they occur as sea pens (Order Pennatulacea). There is a calcareous form that occur as deep as 100 m (*Epiphaxum* in Order Helioporacea). (Bayer, 1954; 1961; Cairns & Bayer, 2009). Species of Octocorallia have been documented in all of the world's oceans from the shallow sublittoral to the deep abyssal zone; however, the diversity of the group varies across basins. The last assessment of the distribution of deep-sea coral taxa in US waters (2017) identified 230 deep-sea coral species in the Gulf of Mexico. Of those 120 were octocorals, with 107 species belonging to the Order Alcyonacea (Etnoyer & Cairns, 2017). These numbers have and will continue to fluctuate over time given the growing number of samples and explorations, the likelihood of cryptic species, and the continued revisions within families highlighted as necessary by recent phylogenetic work on Octocorallia (McFadden et al., 2010; Quattrini et al., 2014; Wirshing et al., 2005). However, the standards for morphological diagnoses are still the classifications set forth by Bayer (1981) and Williams (1995).

Of the different varieties of octocorals, the sea fans (aka gorgonians) are the most common and conspicuous components of the deep rocky reefs in the Northern Gulf of Mexico (Rezak et al., 1985; Gittings et al., 1992). Sea fans are also a functional constituent of the reefs they inhabit. As suspension feeders they serve as 'living sediment traps' that capture particulate organic matter and reduce sedimentation (Sherwood et al. 2005). Turbulent flows are generated due to their size and shape creates micro-habitats for other sessile invertebrate fauna on the back reefs (Peccini & MacDonald, 2008). Sea fans are long-lived, slow growing, and fragile (Andrews et al., 2002; Prouty et al., 2014). They contribute to marine biodiversity, increase habitat complexity, and provide refuge for other marine life (Kahng et al., 2010; Sanchez et al., 2019). Their size and branching structure provides refuge for prey species such as shrimp, crabs, and small demersal fishes. The corals are linked to larger commercially valuable species in the snapper/grouper complex that are often protected or tightly managed and regulated (Weaver et al., 2002, Ross et al., 2010). They are susceptible to many threats (climate change, predation, disease, fisheries activities) which make sea fans an important indicator of reef and ecosystem health (Fisher et al., 2014; Sanchez et al., 2014; Etnoyer et al., 2016, Silva et al. 2016). This makes accurate knowledge of the range and extent of individual sea fan species of paramount importance.

The focus area of this photo guide is the Pinnacle Trend, a belt of discontinuous rocky-plateau structures that stretches from the Mississippi River Delta to De Soto Canyon (29.15 N, 88.53W to 29.6 N, 87.35W). The Pinnacle Trend includes hundreds of topographic features of varying dimensions (Gittings et al., 1992). There are nine named features in the Pinnacle Trend (Gardner et al., 2000). Of these nine, three were sampled during the Deep Water Horizon Natural Resource Damage Assessment (DWH NRDA) (Etnoyer et al., 2016). The sites targeted were Alabama Alps Reef (AAR) and Roughtongue Reef (RTR), which are both large high-relief platform reefs within the Pinnacle reef tract. Yellowtail Reef (YTR) is a lower relief reef adjacent to RTR that was also targeted. The term 'reef' is used because these features originated as accreting reefs during the pre-Pleistocene and were submerged as sea-level rise outpaced the calcium carbonate deposition rate of reef organisms (Sulak & Demopoulos, 2011).

The objective of this photo identification guide is to provide documentation of Alcyonacean specimens collected and/or photographed from the Pinnacle Trend, using *in-situ* and *ex-situ* photography, with light microscopy and scanning electron microscopy (SEM). The collection of samples utilized from the DWH NRDA does not represent a comprehensive census of every taxon that could possibly occur in the area. However, it provides edification of the most common taxa observed and collected. The aim of this guide is to help support video/image based analysis in future surveys of the area. The guide provides remarks regarding the recommended level of precision in terms of identifications from *in-situ* imagery. Such knowledge provides a necessary baseline for future studies investigating these critical organisms.

Methods

Field Sampling Methods

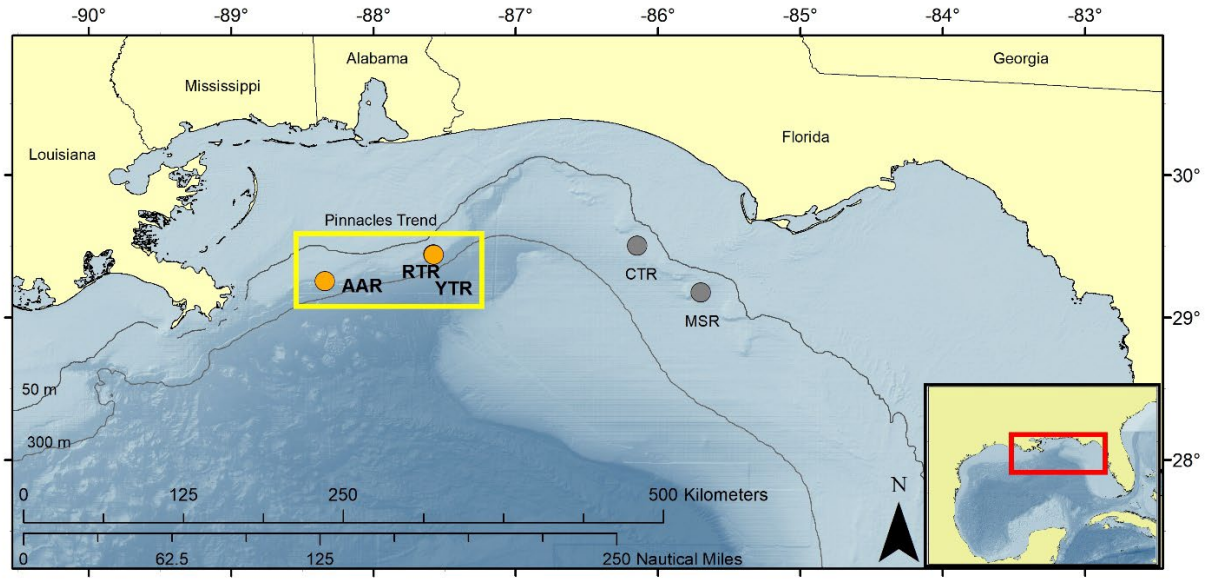

Figure 1. Map of the primary reefs surveyed during DWH NRDA. Pinnacle Trend reefs are highlighted in the yellow box west of De Soto Canyon. There were two additional reefs sampled east of De Soto Canyon during the DWH NRDA, which are marked in grey, but are not the focus of this guide. All reefs sampled during the DWH NRDA are considered to be located in the NE Gulf of Mexico.

Research cruises to investigate the mesophotic reefs at Pinnacle Trend took place in 2010, 2011 and 2014 as part of the DWH NRDA. Methods for the imaging and collection of corals were based on protocols outlined in Etnoyer et al. (2006). In 2010, ROV operations took place from August 1st to August 8th on board the NOAA ship *Nancy Foster*. The 2011 cruise operated from September 15th through September 30th utilizing the OSV *Holiday Chouest.* The 2014 cruise ran from June 22nd through July 13th on the University of Miami R/V *Walton Smith*. All three cruises conducted operations along the Pinnacle Trend, primarily targeting AAR, RTR, and YTR. During the DWH NRDA two additional sites east of De Soto canyon on the West Florida shelf were selected and used as comparison sites. The two comparison sites utilized were Coral Trees Reef (CTR) and Madison Swanson Reefs (MSR) with samples collected from both the North and South reef (Etnoyer et al., 2016). However, taxa unique to those locations are not the focus of this document (Figure 1).

ROV imaging and sampling systems

Both the 2010 and 2014 cruises utilized the same ROV, the Deep Sea Systems International (DSSI) Global Explorer ROV (Deep Sea Systems International, Cataumet, MA). The ROV utilized in 2011 was a UHD-34 provided by UHD Schilling Robotics. Both platforms were set up to provide a similar degree of imaging and sampling capabilities.

The Global Explorer ROV was equipped with three video cameras and a digital still camera in 2014. A pair of 3.8X zoom DSSI Ocean ProHD cameras positioned at a slight angle to each other to provide 3-D footage cameras and an 18 megapixel DSSI DPC-8800 digital still camera, were mounted to a centrally located pan-tilt bracket 61 cm from the bottom of the ROV. The third video camera was a 10X zoom DSSI Ocean ProHD mounted on the top work bar pointed down at a fixed 70 degree down angle (Randall et al., 2014). The main difference in setup between 2010 and 2014, was the additional video cameras for 3D footage that were present in 2014 (Sulak & Demopoulos, 2011). During all years, four green lasers were mounted in a lens ring, set at 10 cm apart. The Global Explorer ROV collected corals with a single Orion seven-function manipulator arm. Samples were then placed in either a centrally mounted extendable bio-box or an extendable port-side mounted rack of 6" diameter PVC quivers (Sulak & Demopoulos, 2011; Randall et al., 2014).

The UHD-34 ROV was equipped with a top mounted digital still camera and a bottom mounted video camera. The digital still camera, mounted on the upper pan and tilt, was an Imenco SDS 1210, with Zeiss 7.9-23.7 mm lens, with 3x zoom capability. The video camera, mounted on the lower pan and tilt, was an Insite Pacific Inc. Mini Zeus high-definition CMOS HDTV camera, with 5.1-51 mm lens, capable of 10x zoom. The UHD-34 ROV utilized either an Atlas manipulator, modified with a cutting blade and anvil or a Titan T-4 manipulator which could break the coral stolon with a twisting motion. Collected samples were placed in either a PVC biobox with closing PVC lid or PVC quivers with rubber stopper lids, both of which were bolted to the front frame of the ROV (Sulak, 2011).

Morphological analysis

Initial identification of 153 samples (2010: n=31, 2011: n=58, 2014: n=64) took place during collection, and was made based off gross morphological characteristics (branching patterns, size, color). Identifications made during collection were then followed by a more rigorous evaluation of sclerite morphology via light and scanning electron microscopy. The features used to differentiate species were based on the best available literature and are summarized and presented in a morphological key (see key on pages 6-7).

Light Microscopy Analysis

An Olympus SZX16 dissecting scope with an attached Canon Rebel T3 digital SLR was used to assess sclerite composition. A clipping of a terminal branch was removed from the sample and was placed on a Fisherbrand glass slide. The clipping was briefly dipped in an 8.25% sodium hypochlorite solution and rinsed with deionized water to cease tissue digestion. This allowed clear viewing of the location of sclerites within the colony. This subsample was then placed on

black polymer clay to provide a high contrast background and provide a surface with resistance while manipulating the subsample during analysis. The clipping was separated into calicular and cortical material using a stainless steel scalpel and forceps. Slides were allowed to desiccate and saved for subsequent viewing and review of identifications.

Scanning Electron Microscopy Analysis

Samples with small sclerites or those diagnosed via the surface texture of particular sclerites were prepared for Scanning Electron Microscopy (SEM). Preparation for SEM occurred in either 5ml micro-beakers or 2ml micro-centrifuge tubes. Organic material was removed with a solution of 8.25% sodium hypochlorite followed by a rinse with pharmaceutical grade hydrogen peroxide (3%). The material then received a minimum of three rinses with deionized water to wash away mineralization or other debris, and then rinsed twice in 95% ethanol to aid drying. The sclerites were then transferred to a fisher brand glass slide. Individual sclerites were selected and placed on a 12mm aluminum mount with carbon adhesive using a dampened fine bristle paint brush and a Konus field dissecting scope (model 5424). Alternatively, the sclerites of some samples were applied to the aluminum mount via "sprinkling" the sclerites uniformly across the carbon adhesive by tapping the edge of the glass slide. This alternative method was primarily used for samples with small, difficult to isolate sclerites. The aluminum mounts were placed in a desiccator for 24 hours and then coated in a 10 nm thick layer of gold palladium using a Denton Vacuum Desk V (Moorestown, NJ) sputter coater. Coated stubs were then examined and imaged at 15 kV with a JEOL JSM5600LV scanning electron microscope.

Results and Discussion

This study compiled in-situ, ex-situ, light and electron micrographs for 23 species; producing SEM plates for nine species for the first time in published literature. Of these, at least 13 species are reported as injured resources in literature associated with Deepwater Horizon oil spill (Silva et al., 2016; Etnoyer et al., 2016). A dichotomous key is provided, in keeping with DeVictor and Morton (2010). The information compiled in this guide should enhance the ability to recognize these taxa in future surveys, both as images and samples in the laboratory.

During this study there were several specimens that contained unique but uncertain morphology and require further investigation. Future efforts should target these four Alcyonacean genera; *Placogorgia*, *Nicella*, *Ellisella*, and *Villogorgia*. Additional specimens of these particular taxa would help to elucidate whether samples that could not be diagnosed morphologically with a high degree of confidence are truly unique species, or the degree of variability in diagnostic features is phenotypic variation. Only those taxa with a high degree of certainty in the diagnosis were included in this guide, and they do not represent the entirety of the Alcyonacean population that may exist across the Pinnacle Trend. This guide also does not include taxa from the orders Pennatulacea, Antipatharia, Scleractinia, or the family Stylasteridae. A comprehensive resource for the Pinnacle Trend or the Gulf of Mexico as a whole should address these taxa as well as those presented here, and do so both morphologically and genetically.

Acknowledgements

Special thanks are owed to Dr. Stephen Cairns for his guidance and support with the species identification presented in this manuscript. Similarly, Eden Couch was instrumental in sample preparation and assisting with identifications. Gratitude also needs to be expressed for the efforts of fellow partners in this research, Dr. Ken Sulak and Dr. Ian MacDonald. The captain and crews of NOAA ship *Nancy Foster*, OSV *Holiday Chouest*, and R/V *Walton Smith* and the ROV teams from Deep Sea Systems International and Schilling Robotics were all critical to the success of this research. Thanks to Enrique Salgado of CSS-Inc., for review and accessibility compliance. Funding from the NOAA Deep Sea Coral Research and Technology Program was used to support the drafting of this document.

Morphological key to Alcyonacean octocorals of Pinnacle Trend presented in this guide.

1. Colonies are unbranched, of few whip-like branches_____ 2
- Colonies are highly branched_____ 3
2. Colony with prominent biserial calices, colony color orange_____ *Ellisella elongata*
- Colony with minimally to moderately raised calices, occasionally on one side, color white _____ *Ellisella* sp.
3. Branched colony, coenenchyme with an outer layer of large sclerites _____ 4
- Branched, coenenchyme with an outer layer of small rods, spindles, capstans, or rosettes _____18
4. Outer layer of coenechyme consists of layer of large thick plates or flat spindles, tightly fit or with smaller spindles in interstices _____ 5
- Coenechymal sclerites may be large but not forming a "pavement" like layer14
5. Outer surface of coenenchyme consists of plates with undulated or "wash-board appearance"; calices with eight marginal lobes formed by converging sclerites (genus *Thesea*) _____6
- Outer surface of coenenchyme consists of large tightly packed spindles, spindles regularly greater than 2 mm, some as large as 4 mm _____12
6. All or some sclerites are red _____7
- None of the sclerites are red _____8
7. The outer coenenchyme consists of red sclerites and the inner coenenchyme consists of white sclerites; with that branches are laterally compressed and thicken at the distal tips _____*Thesea rubra*
- The outer and inner coenenchyme consists of red sclerites; with branches that are not laterally compressed and maintain a constant thickness through the distal tips _____ *Thesea granulosa*
8. All sclerites are orange _____ *Thesea citrina*
- All sclerites are white _____9
9. Outer layer of sclerites comprised of numerous double heads and double cones in addition to flattened spindles, fairly uniform in size, colony color varies from purple to red _____ *Thesea nivea*
- Double head and cone shaped sclerites are rare or absent from the outer layer_____10
10. Double cones are rare in the outer coenenchyme, colony color can appear grayish _____*Thesea hebes*
- Double cones are absent, and colony color is white _____ 11
11. Calices are low and barely raised above the surface of the coenenchyme __*Thesea parviflora*
- Calices are conical and prominent, calices raised above the surface of the coenenchmye, colony sparsely branched _____*Thesea guadalupensis*
12. Cylindrical or conical calices _____13
- Shelf shaped calices _____ *Muricea pendula*

13 Small colony, biserial cylindrical polyps_____*Scleracis guadalupensis*
- Small-moderate size colony, biserial conical polyps_____ *Scleracis* sp.

14 Calicular sclerites are thorn-scales or thorn-spindles, coenenchymal sclerites are spindles _____ 15
- Calicular sclerites are thorn-scales, coenenchymal sclerites are 4-arm radiates having a central projection _____*Villogorgia nigrescens*

15 Calicular sclerites are thorn-scales_____ 16
- Calicular sclerites are thorn-spindles, thorn spindles are also present in the coenechyme, also contains y-shaped crosses and multi arm radiates _____*Muriceides hirta*

16. Coenenchymal sclerites are elongated spindles without projecting spines ___*Paramuricea* sp.
- Coenenchymal sclerites are spindles with occasional projecting spines _____17

17. Coenenchymal sclerite is a spindle with a single projecting spine, opercular rod is a single crutch shape _____*Placogorgia tenuis*
- Coenenchymal sclerite is a spindle with multiple projecting spines, opercular rod is a pair of smooth curved rods _____*Placogorgia rudis*

18. Sclerites of the body wall interlocking and fusing to form small to large clumps, sclerites are slender rods ornamented with thorns _____*Carijoa riisei*
- Sclerites are rods, spindles, capstans, or rosettes that do not fuse _____19

19. Sclerites are small rosette cups, multi-arm radiates and stellate plates _____20
- Sclerites are rods, spindles, or capstans _____21

20. Stellate plates are thick and warted, only contains 4 arm radiates _____ *Bebryce grandis*
- Stellate plates are amoeboid shaped, contains 4 and 6 arm radiates _____ *Bebryce cinerea*

21. Sclerites of the calyx distinctly larger than those of the coenenchyme _____22
- Sclerites of the calyx and coenenchyme the same size, sclerites consist of girdled spindles and smooth rodes, the colony has long thin slender branches, mostly dichotomous in branching pattern with low-absent calices_____ *Leptogorgia violacea*

22. Colony is abundantly branched with short numerous terminal branches, distinctly branching in one plane, domed calices, sclerites consist of flat or round rods and double heads _____23
- Colony is loosely branched, typically branching in one plane but can appear bushy, prominent conical calices, sclerites consist of spindles and capstans_____*Swiftia exserta*

23. Sclerites contain non-girdled flattened rods _____ *Nicella americana*
- Sclerites contain round-rods _____ *Nicella* sp.

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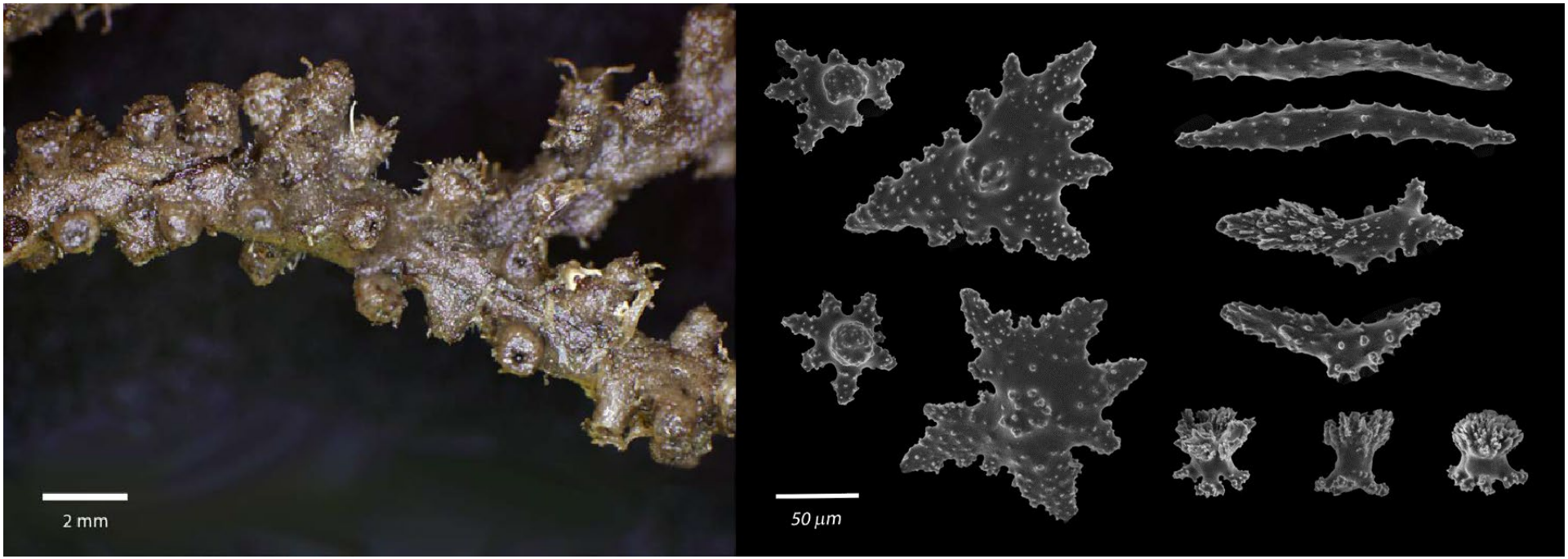
Photo-identification guide to the octocorals of Pinnacle Trend

Bebryce cinerea Deichmann, 1936

Distribution: This species has been documented in both the northeast and northwest Gulf of Mexico in the depth range of 64 - 274 meters (Etnoyer & Cairns, 2017). It is also present in the Southeast US waters (SEUS) and throughout the Caribbean, and as far south as Brazil (NOAA DSCRTP, 2020).

Description: *Bebryce cinerea* is a small, yellow-colored colony that branches in one plane. The colonies are typically around 10 cm (Deichmann, 1936), though some colonies collected from the Pinnacle Trend verged on 20 cm. Colonies are yellow in life and yellow-brown to brown when preserved in ethanol. Branches are typically 1-2 mm in diameter. Calyces are cylindrical and reach a height of 2 mm and 1 mm in width, mostly crowded along two sides of the branches in a relatively alternating manner (Deichmann, 1936). Most of the polyps are typically contracted but can also be retracted. Colonies are typically covered with a variety of epibionts, typically; ciliates, foraminifera, hydroids, bryozoans, and polychaete worms (Bayer & Ofwegen, 2016).

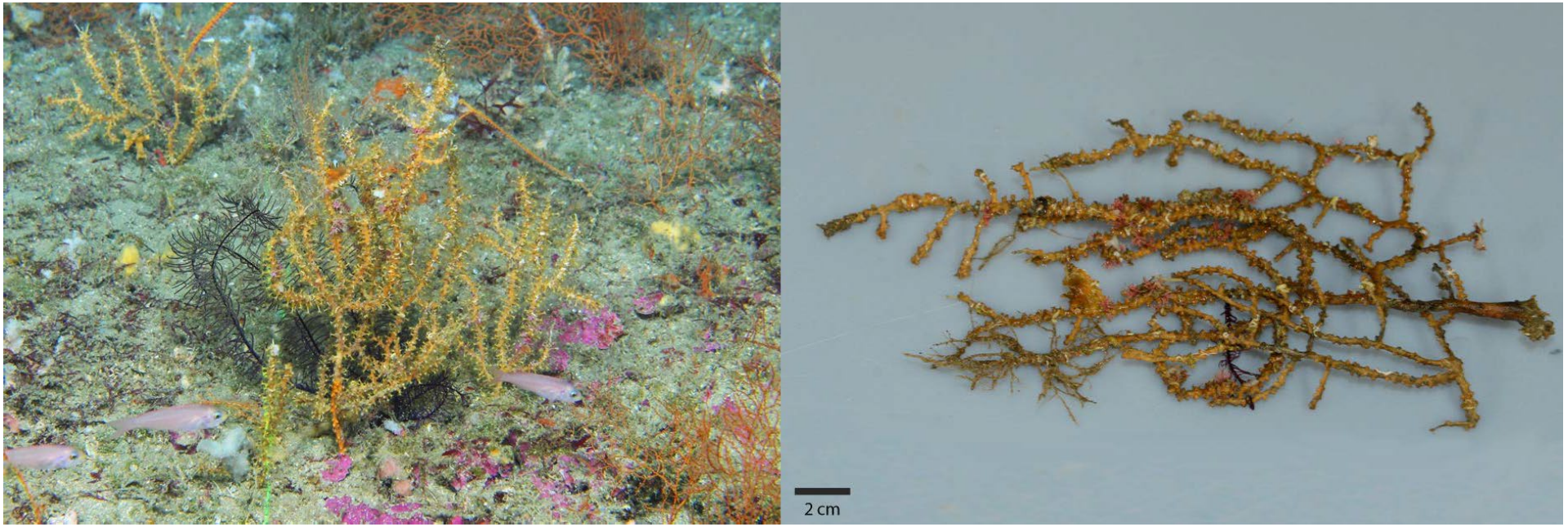
Bebryce cinerea Deichmann, 1936



Description (*cont.*)**:** The genus *Bebryce* is identified by the presence of stellate plates (left of center of the SEM plate), rosette cups (bottom right of SEM plate), and four or six-arm crosses (far left of SEM plate) (Bayer, 1981; Bayer & Ofwegen, 2016). Of these, the shape and size of stellate plates and the dominance of either four or six-arm crosses seems diagnostic. In *B. cinerea*, small six arm stars and amoeboid stellate plates are predominant (Devictor & Morton, 2010; Bayer & Ofwegen, 2016). In the material examined from Pinnacle Trend, the amoeboid stellate plates indicative of the species were triangular in appearance. Sclerite morphology must be examined to differentiate *B. cinerea* from other *Bebryce*.

Remarks: Given its small size, *in-situ* identification of this genus requires good lighting, high-resolution cameras, and close proximity to the seafloor. The presence of epibionts is a clue to *Bebryce*, however other genera can be mistaken for *Bebryce*. These genera include yellow colonies of *Scleracis*, *Caliacis nutans*, and other small Plexauridae. A species-level identification (ID) is only appropriate from a sample, never from images. A genus level ID is only advisable from high quality *in-situ* images with good proximity to the subject. The safest level of identification for this species from video would be a ‘small yellow Plexauridae’.

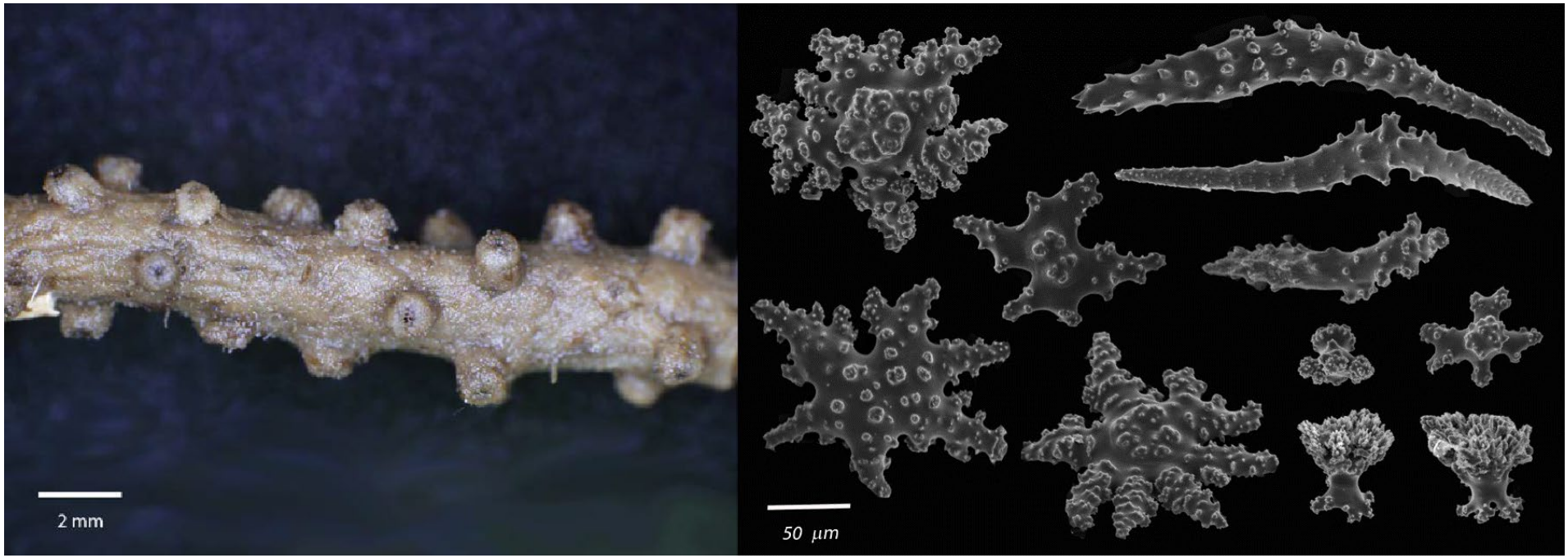
Bebryce grandis Deichmann, 1936



Distribution: This species has been documented in both the northeast and northwest Gulf of Mexico ranging from 58- 100 meters (Etnoyer & Cairns, 2017). This species is endemic to the Gulf, it has not been documented outside of the Gulf of Mexico in US waters (Cairns & Hourigan, 2017). It has been collected throughout the western Caribbean and Lesser Antilles, as well as the Bahamas (NOAA DSCRTP, 2020).

Description: *Bebryce grandis* is a small, uniplanar, yellow-colored colony. Colonies are less than 20 cm in size and often less than 10 cm. Colonies are yellow in life and yellow-brown to brown when preserved in ethanol. Branches are typically 2-3 mm in diameter. Calyces are cylindrical but only ~2 mm in height, with more space between calyces than other *Bebryce* (Deichmann 1936; Bayer & Ofwegen 2016). Most of the polyps are typically contracted but can also be retracted. Colonies are occasionally covered in the same variety of epibionts as *B. cinerea*, however, *B. grandis* is more commonly free of epibionts (Bayer and Ofwegen 2016).

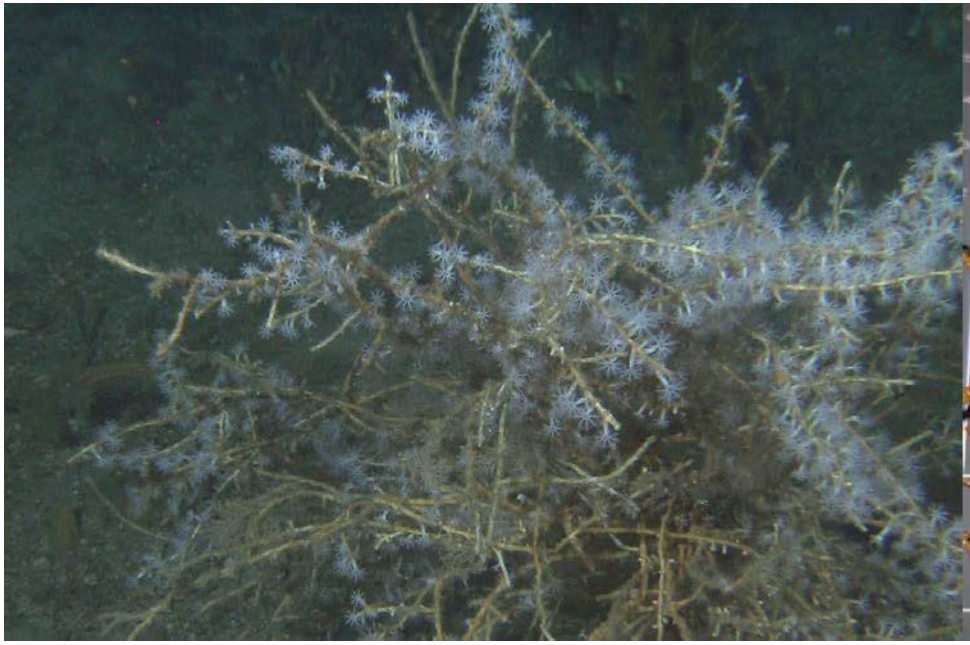
Bebryce grandis Deichmann, 1936



Description (cont.): The genus *Bebryce* is identified by the presence of stellate plates (left side of SEM plate), rosette cups (bottom right), and four or six-arm crosses (left of center) (Bayer, 1981). *B. grandis* is distinguished by the predominance of four-arm crosses, and thicker, heavily-warted stellate plates (Bayer & Ofwegen, 2016). Sclerite morphology is required to differentiate from other species of this genus. The shape and size of stellate plates and the predominance four or six-arm crosses are diagnostic.

Remarks:
Same as *B. cinerea*

Carijoa riisei (Duchassaing and Michelotti, 1860**)**



Distribution: This species has been documented in both the northeast and northwest Gulf of Mexico in a depth range of 58-100 meters (Etnoyer & Cairns, 2017). It ranges from the southeastern US through the Caribbean to the coast of Brazil (Devictor and Morton, 2010). It has also been documented in Hawaii (NOAA DSCRTP, 2020)

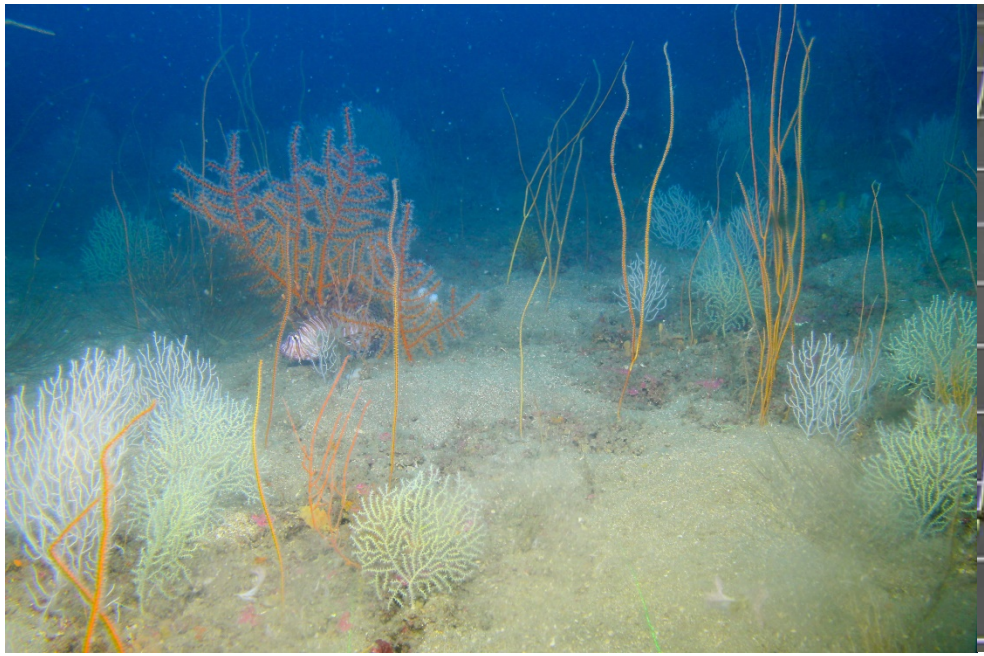
Description: This species is a densely-branched Clavularidae (Devictor & Morton, 2010). Colonies can be large and bushy with long cylindrical calyces (Bayer, 1961). In seafloor images, the colonies may appear very similar to the genus *Telesto*.

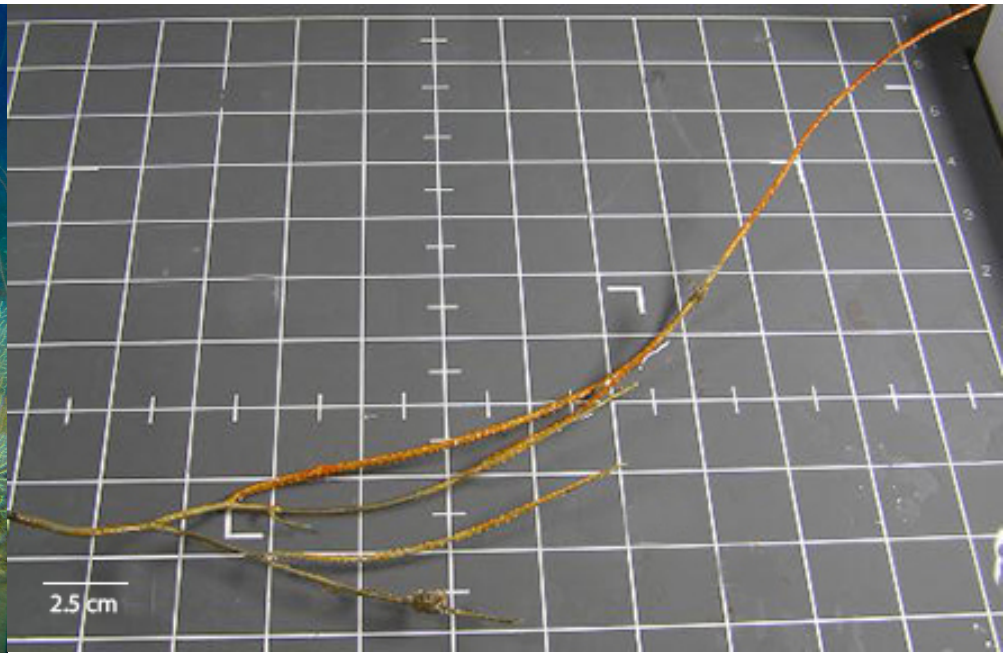
Carijoa riisei (Duchassaing and Michelotti, 1860)

Description (*cont.*): However, *Carijoa riisei* is easily differentiated through light microscopy by the presence of branching thorny rods and spindles (top portion of SEM plate), with minor fusion of the thorny rods (bottom portion of SEM plate), instead of the granular bodies indicative of *Telesto*. *Carijoa* is considered a fouling organism (Devictor & Morton, 2010).

Remarks: Though sclerites are the definitive means to differentiate *Carijoa riisei* from similar species, the size and type of branching can support a fairly confident field identificationat the genus or even species level.

Ellisella elongata (Pallas 1766)

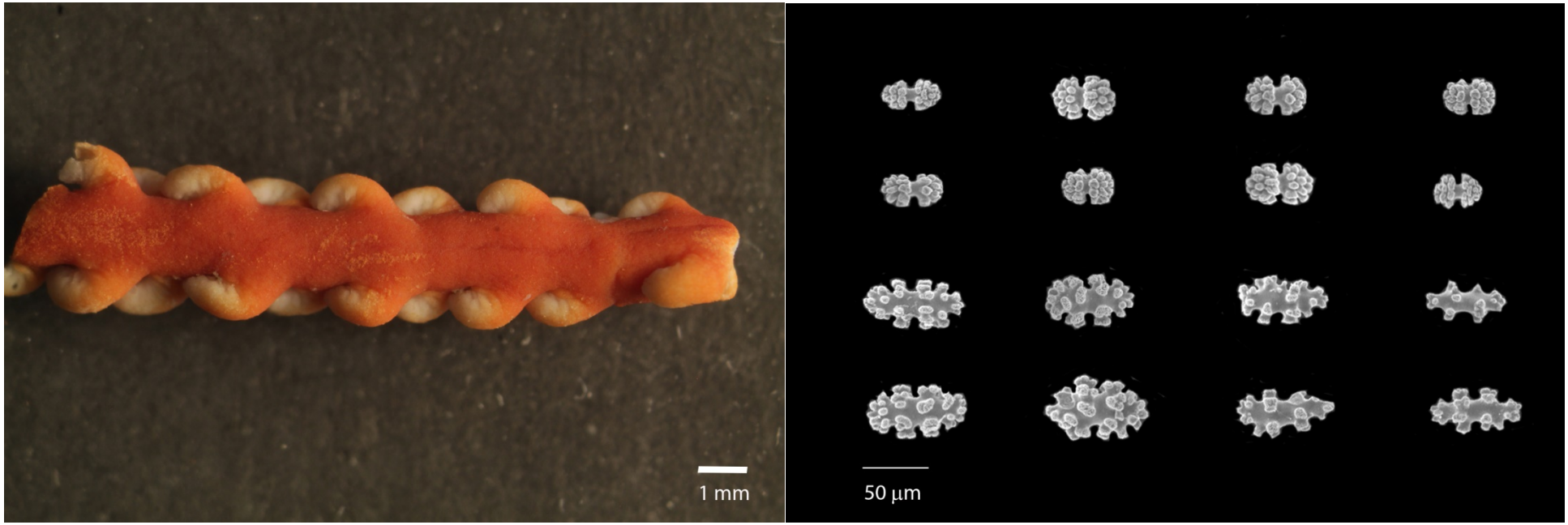




Distribution: This species was synonymized with *Ellisella barbadensis* in 2010 (Castro et al., 2010) and has been documented in northeast, northwest, and southeast Gulf of Mexico and at a depth range 20 - 479 meters (Etnoyer & Cairns, 2017). This species is also commonly found in both the SEUS and throughout Caribbean waters, with records distributed as far as the southern coast of Brazil (Cairns & Hourigan, 2017; NOAA DSCRTP, 2020).

Description: *Ellisella elongata* is typically an unbrached flagelliform colony, however, multiple whips can originate for a single base in some instances, illustrated in the *ex-situ* image above. Colonies are often quite long, frequently greater than 2 meters, the base can be as thick as 8 mm and the colony tapers toward the distal tip. Calices are upturned and prominent, and are bi-serially arranged often in multiple lateral bands (illustrated in the micrograph of the axis on the next page). The color of the axis is typically orange, and polyps are white (Bayer, 1961).

Ellisella elongata (Pallas 1766)



Description (*cont.*): Sclerites in this species are predominantly 'dumb-bell' forms. The coenenchymal sclerites consist of an abundance of double cones which are typically around 0.06mm (Top half of SEM plate), and an infrequent capstan that reaches 0.07-0.08 mm (bottom left of SEM plate). The sclerites of the calices are predominantly double spindles which can be as large as 0.11 mm (bottom right of SEM plate). Sclerites of the outer coenenchyme are orange in color, while sclerites from the inner coenechyme and calices are a pale yellow.

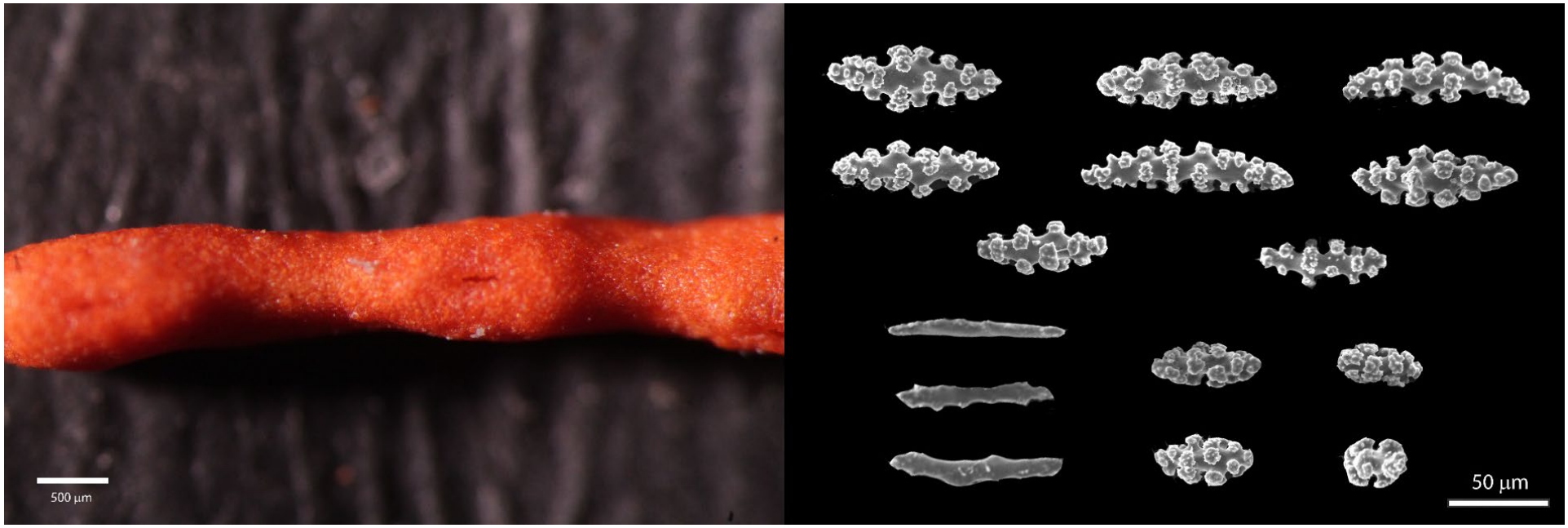
Remarks: Unbranched or minimally branched whip-like colonies are difficult to identify *in-situ* as the characteristics needed to make a diagnosis are too small to see at the distances common in underwater surveys. However, if the lighting and proximity are such to clearly make out the calices and polyps a genus level identification is warranted. This genus not just this species has been the subject of multiple reclassifications (Castro et al., 2010; Devictor & Morton, 2010), as such a species level identification should be avoided without both a specimen to conduct a morphological and genetic analysis.

Leptogorgia violacea (Pallas, 1766)

Distribution: This species was not previously documented in US waters, but it has been documented from Brazil and the Lesser Antilles in the Caribbean at depths shallower than 50 meters (NOAA DSCRTP, 2020).

Description: *Leptogorgia violacea* colonies branch in one plane, laterally, occasionally dichotomously. Branches and branchlets are often flattened. Polyps are biserially arranged with low or absent calyces. There are no descriptions available of the sclerite morphology. The specimen on hand was identified using genetics (Poliseno et al., 2017) and then its morphology compared against a translation of the original Latin description (Pallas, 1766). The gross morphology matched the original description.

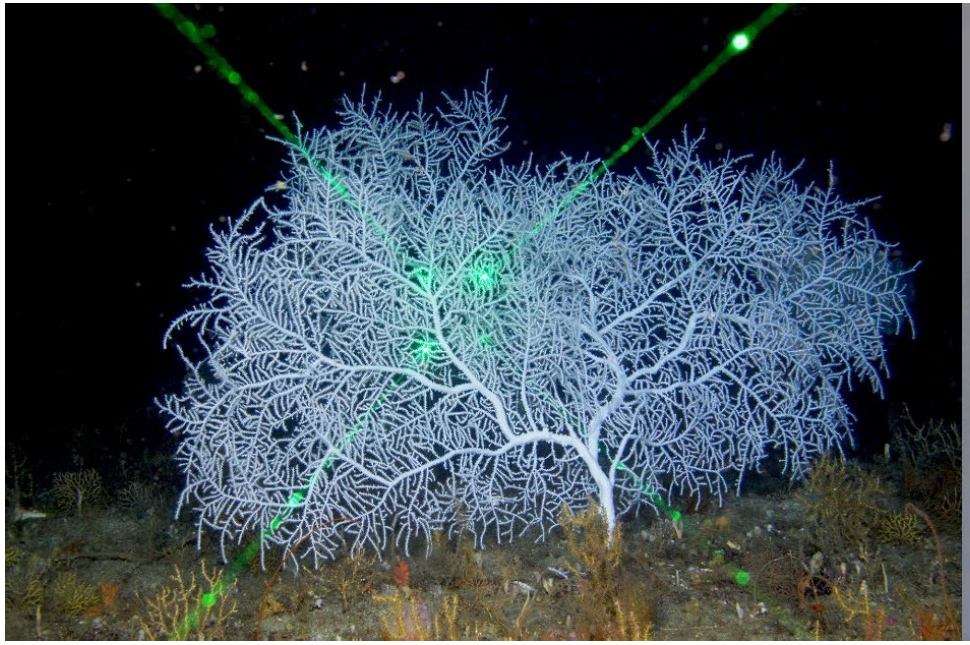
Leptogorgia violacea (Pallas, 1766)



Description (*cont.*): The sclerites present in the coenenchyme and calyx are girdled spindles (top portion, and bottom right of SEM plate) with simple unadorned smooth rods likely coming from the tentacles (bottom left of SEM plate). There was little difference between coenenchymal and calicular sclerites, given the lack of a distinct calyx.

Remarks: *Leptogorgia* is characterized by a lack of specialized sclerites and branching patterns, which make it difficult to identify *in-situ* (Bayer, 1957). Species level identifications in the lab would greatly benefit from genetic verification. Given the degree of uncertainty even with a sample on-hand, a species-level ID is not recommended from *in-situ* images. A genus-level ID can be made, but the safest level of identification in the field would be 'slender orange Gorgoniidae'.

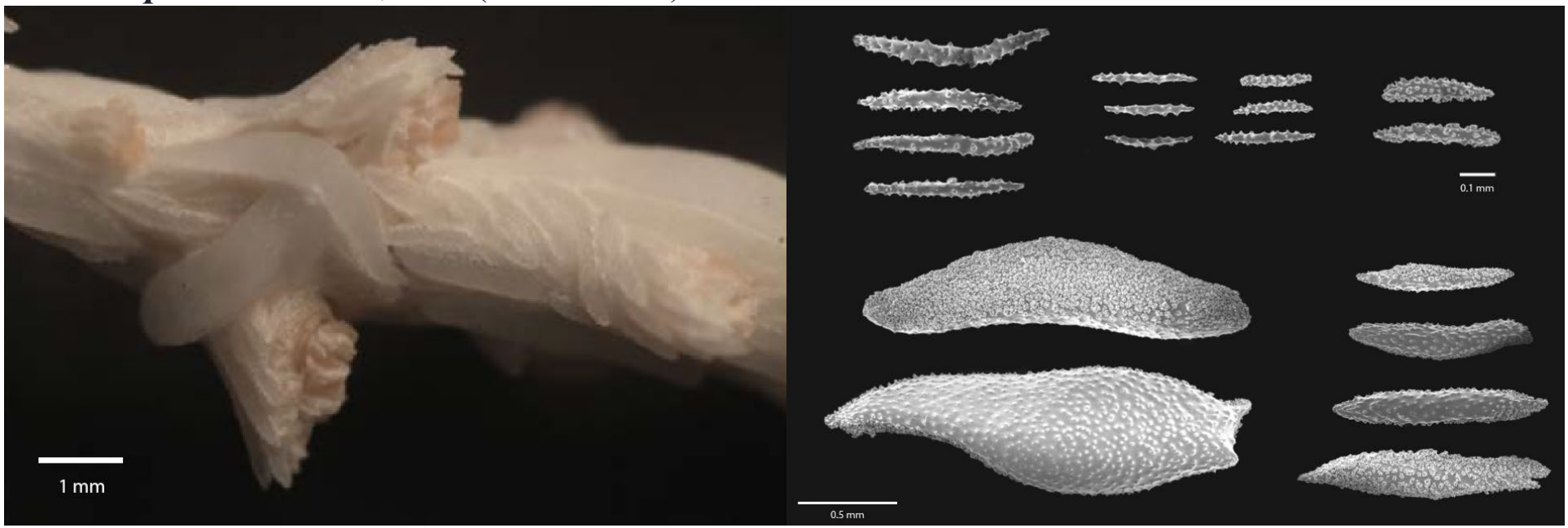
Muricea pendula Verrill, 1868 (white variant)



Distribution: This species has historically been identified as *Hypnogorgia pendula* in the Gulf of Mexico. Recent genetic studies have shown this species to be genetically indistinguishable from *Muricea pendula* (Etnoyer, unpublished data). This likely means this variant can be found at the same location documented in northeast and northwest Gulf of Mexico and at the same a depth range (60 - 109 meters) reported in Etnoyer & Cairns, 2017.

Description: This white variant of *Muricea pendula* is a large (50-115 cm), planar, sea fan colony with one or more main stems that give off slender alternating branches. At intervals of ~1 cm these branches give off branchlets in the same manner. The calyces are generally laterally-placed and alternate along the branches. The calyces are shelf-shaped, or better described as perpendicular to the axis on the abaxial side (top) of the calyx, and at a 45 degree angle on the adaxial (bottom) side of the calyx. The color of the colony when preserved in ethanol can vary from white to pink. The primary axis, especially at the base, can be dark while the tissue of the branches can vary from white to pale yellow. The species traditionally described as *Muricea pendula* has a similar shape, and color can vary from orange to red. While there is overlap in the range of the traditional orange/red color morph and this white variant; none of the traditional color morphs were collected or otherwise documented during survey efforts along the Pinnacle Trend.

Muricea pendula Verrill, 1868 (white variant)



Description (*cont.*): Sclerites in this species are exclusively rods and spindles. The calyx consists of a few long projecting rods (top left of SEM plate) in the outer edge, and much smaller ones on the sides side turned toward the axis (top right of SEM plate). There is no collaret present, best illustrated by the lower calyx in the light micrograph of the axis. The coenenchymal sclerites are most prominent and contain large spindles (bottom of SEM plate), the largest of which can range from 2-4 mm. These spindles are mostly arranged lengthwise and form a tight 'pavement' like surfaces. Coenenchymal sclerites are occasionally transversally placed at the base of the calyx.

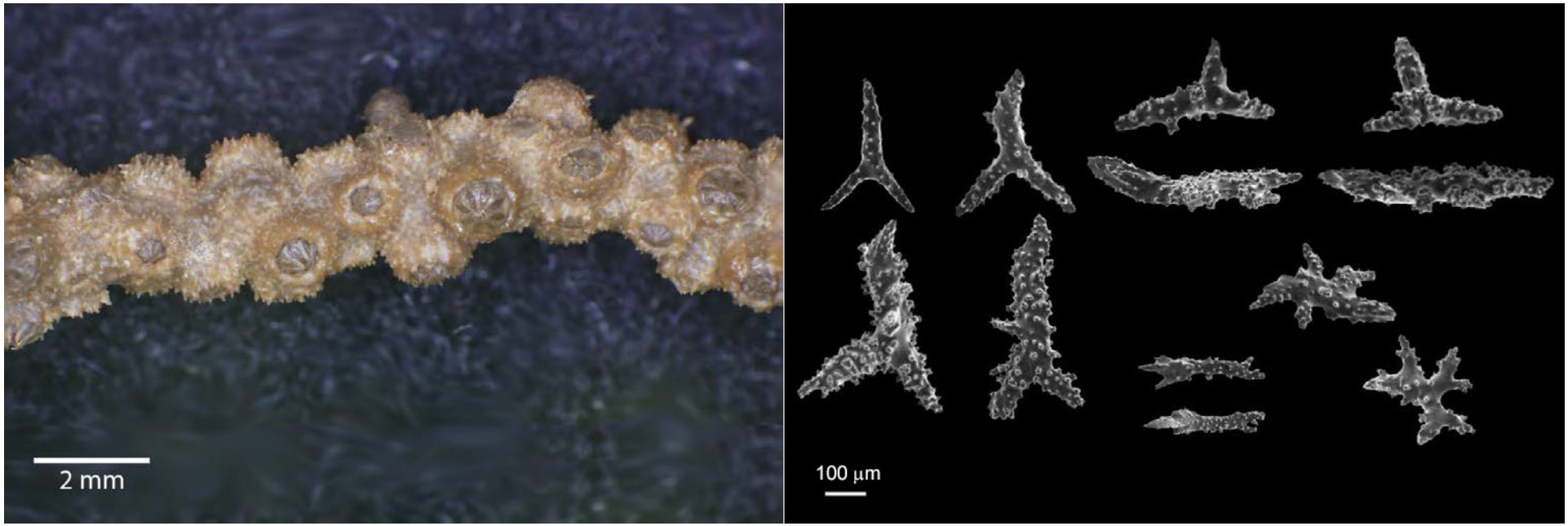
Remarks: The orientation of the calyx and sclerite morphology is very similar to other speices in the genus *Muricea*. The colony color, polyp spacing, and the size of the coenenchymal sclerites are considered to be diagnostic in the literature (Bayer, 1961; Deichman, 1936). Current work is investigating these features in relation to the revelations of the genetic relationship of this variant with *Muricea pendula*. Aspecies-level identification can be made in the Pinnacle Trend, because the branching pattern, size, and color is enough to make a positive ID. In areas where tissue samples are not available, a few specimens should be collected to confirm identification the species-level identification. The pale color can be misleading. Other genera can appear large and white, e.g., *Nicella* in the family Ellisellidae.

Muriceides hirta (Pourtalès, 1868)

Distribution: This species has been documented in the northeast, northwest, and southeast Gulf of Mexico in the depth range from 53 - 595 meters (Etnoyer & Cairns, 2017), and can be found in Southeast US waters (Cairns & Hourigan, 2017).

Description: *Muriceides hirta* is a medium- to large-sized (30-60 cm), yellow sea fan with small conical calyces. Calyces are scattered across the axis and not especially crowded towards the tips (Deichmann, 1936). *Muriceides* can only be distinguished from several similar-looking genera through a microscopic view of sclerite morphology.

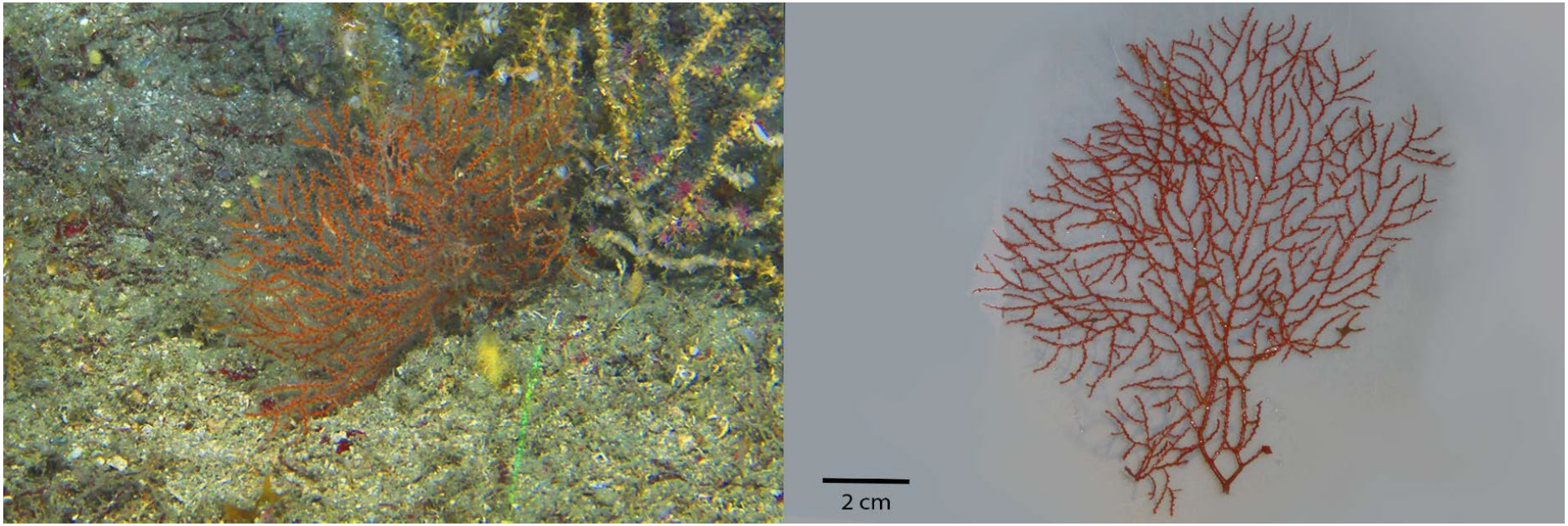
Muriceides hirta (Pourtalès, 1868)



Description (*cont.*): The genus *Muriceides* differs from *Placogorgia* and *Paramuricea* by the presence of thorn spindles in the calyx (second row of sclerites on the right side of SEM plates), instead of thorn scales, (Bayer, 1981). *Muriceides hirta* is differentiated from other species of *Muriceides* by the presence of y-shaped crosses (left side and first row top right of SEM plate) and multi-armed radiates (bottom right of SEM plate) (Bayer, 1957).

Remarks: *Muriceides* colonies share their gross morphology with a large number of similar yellow plexaurids that cannot be differentiated *in-situ* from images. Given this uncertainty, colonies in this species should not be diagnosed beyond the family level from *in-situ* images. The safest level of identification is 'yellow Plexauridae'.

Nicella americana Toeplitz, 1919



Distribution: This species has been documented in the northeast and northwest Gulf of Mexico in a depth range from 62 - 100 meters (Etnoyer & Cairns, 2017). It is common in the Bahamas (Cairns, 2007). The distribution ranges as far south and east as the Greater Antilles and Brazil. The type location is Barbados. This species has not been documented in US waters outside of the Gulf of Mexico (Cairns & Hourigan, 2017).

Description: *Nicella americana* is a densely branched reticulated sea fan, typically pale orange to red in color. The colonies most commonly observed in Pinnacle Trend were less than 20 cm, but can be as large as 60 cm in height (Cairns, 2007). *N. americana* branches profusely starting very close to the base of the colony. Most colonies are bright- to light-orange, while the polyps and calyces are a paler shade of orange, though not fully white. Calyces alternate, in an opposite fashion along the branch edges, although occasionally face the anterior side.

Nicella americana Toeplitz, 1919

Description (*cont.*): *Nicella* species are differentiated by their sclerite morphology (*i.e.*, flat vs round rods) and morphometrics (i.e. L:W ratios) of the body wall sclerites. *N. americana* is distinguished from other *Nicella* by the presence of non-girdled flattened rods (upper center column of SEM plate), that are 0.11–0.18 mm and have an L:W ratio of 5; double heads (bottom center column of SEM plate), that are 40–70 µm with a waist that is 2-5 µm and conical tubercles that are 7-9 mm in height, and needles, that are 0.13–0.15 mm in length with an L:W ratio of 8–11 (Cairns, 2007).

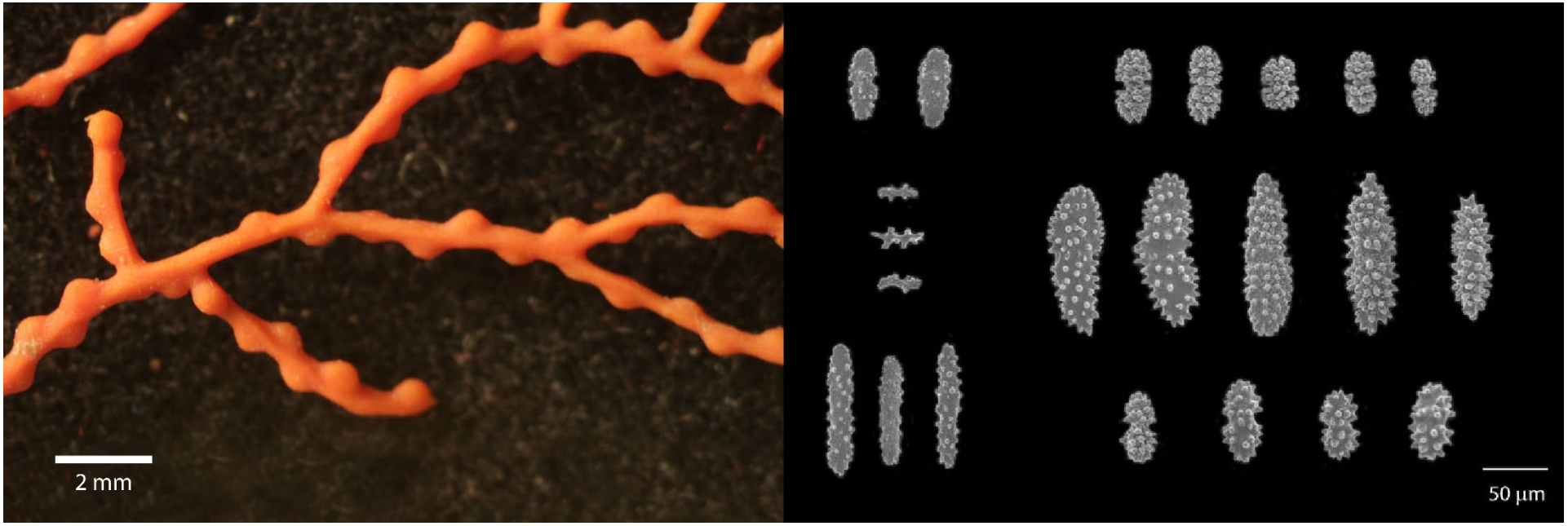
Remarks: It is fairly easy to identify the genus from the density and thinness of branches that extend to the base. A species- level identification is not recommended for any *Nicella* using *in-situ* images. Species level identification requires a microscopic review of the body wall sclerites.

Nicella sp.

Distribution: The undiagnosed species of *Nicella* described here is currently unique to Pinnacle Trend and was collected from 62 meters. Other species within the genus can be found from 45-311 meters in the Gulf of Mexico (Etnoyer & Cairns, 2017) and are also present in both Southeast and Caribbean US waters, as the genus has a relatively global distribution with records in both the Atlantic and Pacific Oceans (Cairns & Hourigan, 2017; NOAA DSCRTP, 2020).

Description: Species of *Nicella* are determined by the characteristics of the double head sclerites and the dominance of either flat or round rods (Cairns, 2007). This species of *Nicella* clearly belongs to this genus, as it contains all of the sclerite shapes indicative of the genus *Nicella* in addition to the typical gross morphology of the colony, however the finer details of the sclerite morphology did not conform entirely with the currently described species, and is described in detail on the following page.

Nicella sp.



Description (*cont.*): The rods and double heads used to diagnose *Nicella* were present but did not match the current combinations indicative of any particular described species of *Nicella*. Of specific note is the fact that all of the described species of *Nicella* have either dichromatic sclerites (orange and white) or white sclerites only (Cairns, 2007), while this species identified from Pinnacle Trends contains all orange sclerites. Further work, specifically a genetic evaluation of this specimen, will be needed to discern if this is a potential new species or a morphological variation of an already existing species.

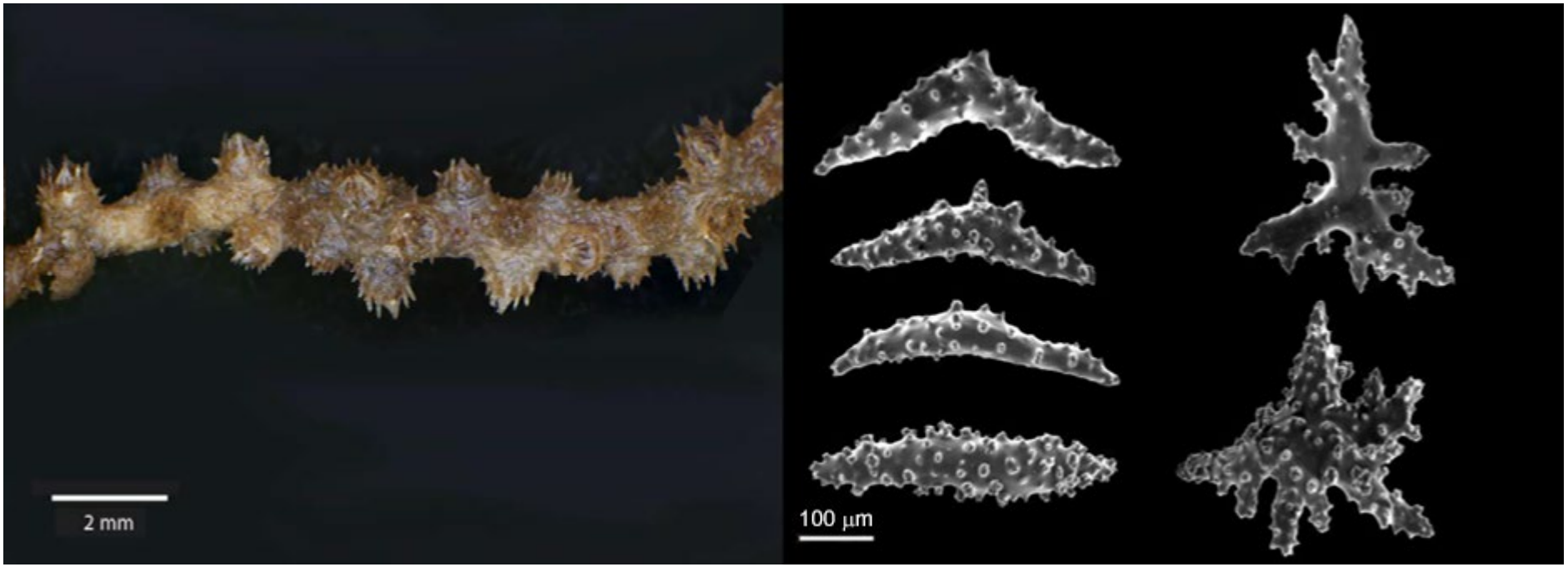
Remarks: This species is indistinguishable from other species of *Nicella in-situ*. Even once this species has been officially described it would still only be advisable to identify it to the genus level *in-situ*.

Paramuricea sp.

Distribution: In the Gulf *Paramuricea* is typically found deeper than 270 meters in the Gulf of Mexico (Etnoyer & Cairns, 2017), much deeper than those collected at Pinnacle Trend. There are species of *Paramuricea* reported shallower, like *P.clavata,* from the Mediterranean and an occurrence of *Paramuricea* described in the Southeast US by Devictor & Morton (2010). However, the specimens collected in the Pinnacle Trend identified as *Paramuricea* did not match any of the described species of *Paramuricea*

Description: The specimens collected that belong to the genus *Paramuricea*, could not be confidently assigned a species level identification even after a thorough comparison to the literature. This morphotype of *Paramuricea* is a medium to large size sea fan (30-60 cm) with low conical calyces. Calyces for this species were predominantly scattered, though with some degree of grouping near the lateral edges, which is common of the genus (Deichmann, 1936). This morphotype is difficult to separate from other species *in-situ*, as its gross morphology is similar to many other genera (*Murceides* and *Placogorgia*). This is further compounded by the variability of color seen in specimens identified to be *Paramuricea*, they ranged from yellow to red. Despite the variability in color all had the same sclerite morphology.

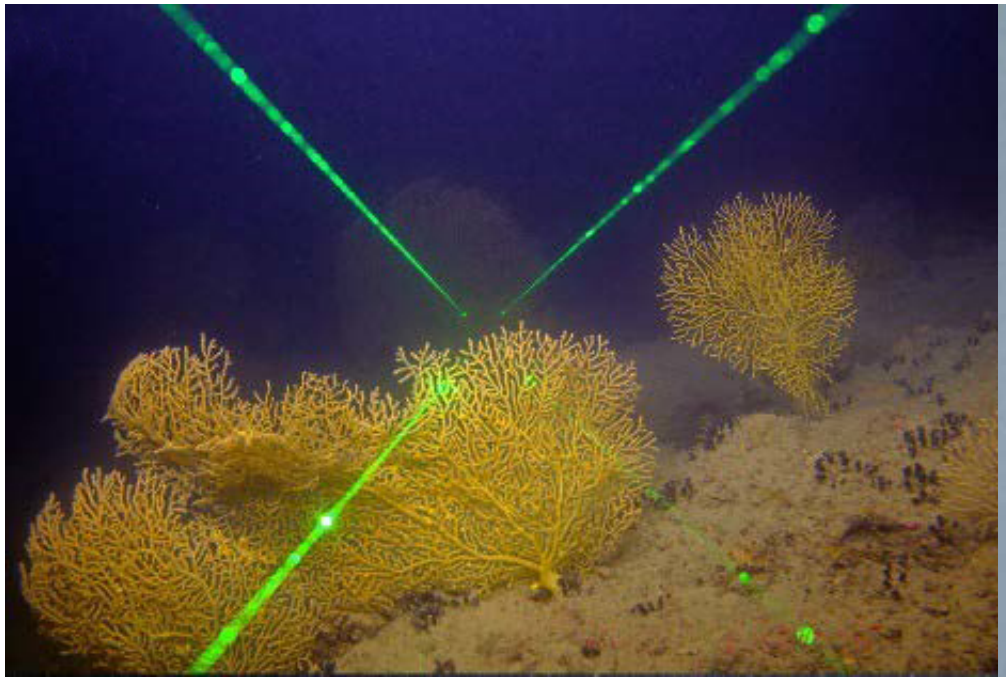
Paramuricea sp.



Description (*cont.*): *Paramuricea* is separated from the closely related *Placogorgia* by the absence of a projecting spine or spines on the cortical spindles (Bayer, 1981). Individual species of *Paramuricea* are distinguished by a combination of the shape and size of the calicular thorn scales, cortical spindles, and opercular rods or sclerites (Bayer, 1959; Grasshoff, 1977). However, the cortical spindles (left hand column) and calicular thornscales (right hand column) of these *Paramuricea* specimens do not conform closely enough to any described species. Devictor & Morton (2010) evaluated a Paramuricea from similar depth ranges in the SEUS. However, the thorn scales present on the Devictor & Morton specimens have a much larger calicular thornscale with tendrils that are more fused than those observed from the Pinnacle Trend specimens, suggesting this morphotype maybe unique to this area.

Remarks: The material examined from the Pinnacle Trend could not be confidently matched to any description in Deichmann (1936) or Grasshoff (1977). This species shares a gross morphology with a large number of similar yellow, red or bicolor Plexauridae that cannot be diagnosed from *in-situ* images. This species should be diagnosed as 'Plexauridae' with a color modifier from *in-situ* images.

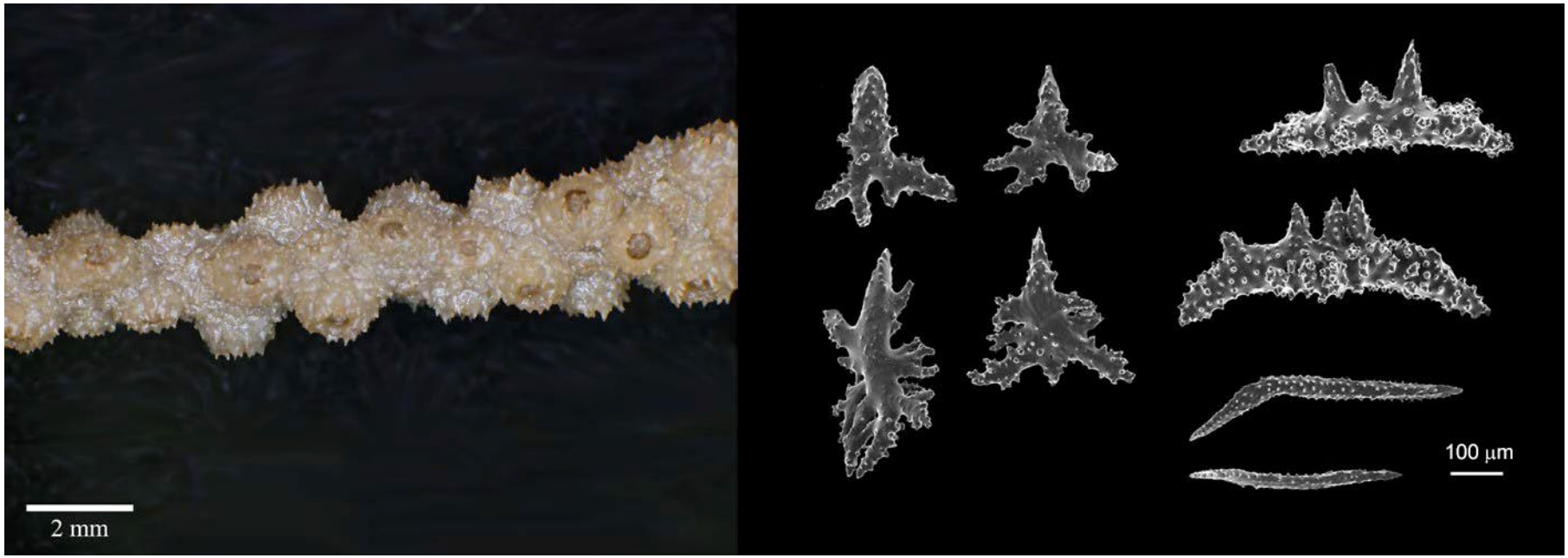
Placogorgia rudis Deichmann, 1936



Distribution: *Placogorgia rudis* has been documented in the northeast and northwest Gulf of Mexico at a depth range from 64 - 127 meters (Etnoyer & Cairns, 2017) and throughout the Caribbean, but has not been documented off the Southeast US or the Bahamas (Cairns & Hourigan, 2017; NOAA DSCRTP, 2020).

Description: *Placogorgia rudis* is a medium to large size (30-60 cm) typically yellow sea fan with small conical calyces. Remarkably, the colonies can have a bi-color appearance exhibiting yellow branches with red or purple color on adjacent branches or at the distal tip. Calyces for this species are scattered and not especially crowded towards the tips (Deichmann, 1936).

Placogorgia rudis Deichmann, 1936



Description (*cont.*): *Placogorgia* can only be distinguished from several morphologically similar genera through study of sclerite morphology. *Placogorgia* is distinguished from the closely related *Paramuricea* by the presence of spined cortical spindles (Bayer, 1981). Species of *Placogorgia* are distinguished from each other by a combination of the shape and size of the calicular thorn scales (left side of SEM plate), cortical spindles (top right of SEM plate), and opercular rods or sclerites (bottom right of SEM plate) (Deichmann, 1936; Bayer, 1959). *P. rudis* lacks the crutch-shaped opercular rod indicative of *Placogorgia tenuis*; instead it contains two simple curved rods. *P. rudis* is further identified by having multiple spines on the cortical spindle, which can vary in length but are never more than 1 mm (Bayer, 1959).

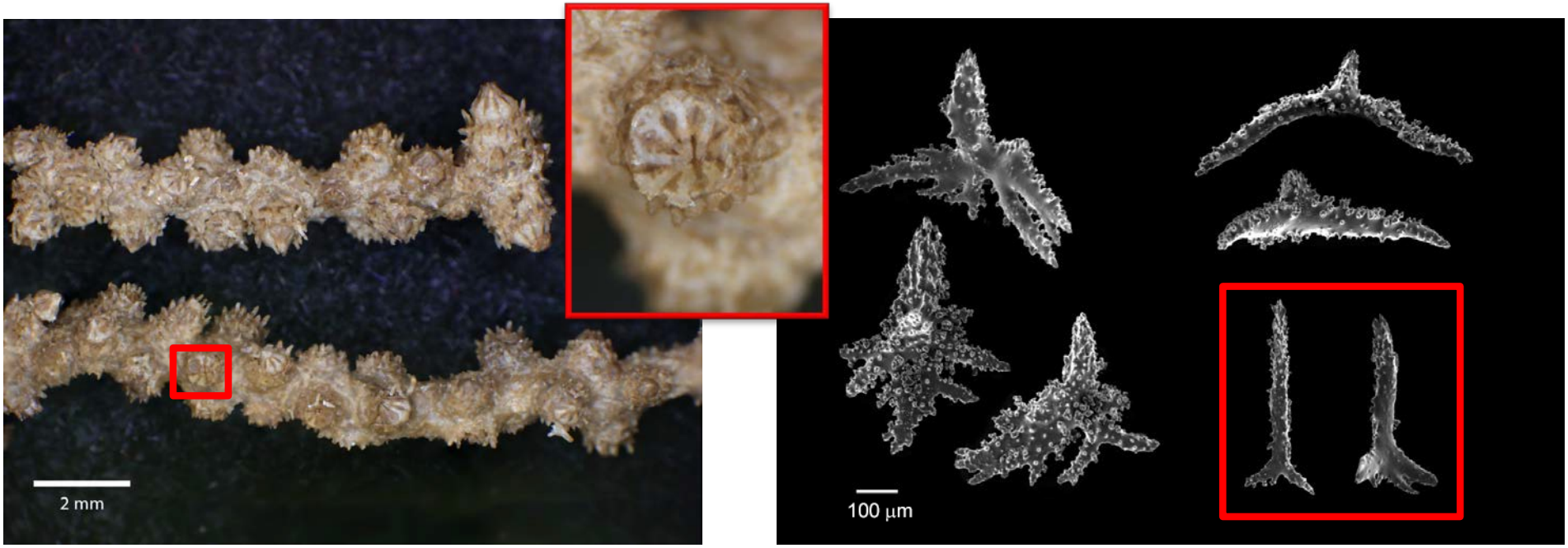
Remarks: This species shares a gross morphology with a large number of similar yellow Plexauridae. Given the degree of uncertainty, this species should not be diagnosed beyond the family level from *in-situ* footage. Identify the colonies as “yellow Plexauridae” or “red/yellow Plexauridae”.

Placogorgia tenuis (Verrill, 1883)

Distribution: *Placogorgia tenuis* has been documented in the northeast and southeast Gulf of Mexico at depths ranging from 76 - 479 meters (Etnoyer & Cairns, 2017). It also occurs thoughout the Caribbean (NOAA DSCRTP, 2020).

Description: This species is a medium to large size typically yellow sea fan with low conical calyces (Deichmann, 1936). As previously mentioned *Placogorgia* can only be distinguished from several morphologically similar genera through microscopic analysis of the sclerties, due to the need to confirm the presence of spined cortical spindles (Bayer, 1981). It should be noted that calyces for this species can vary from laterally placed to scattered (Deichmann, 1936).

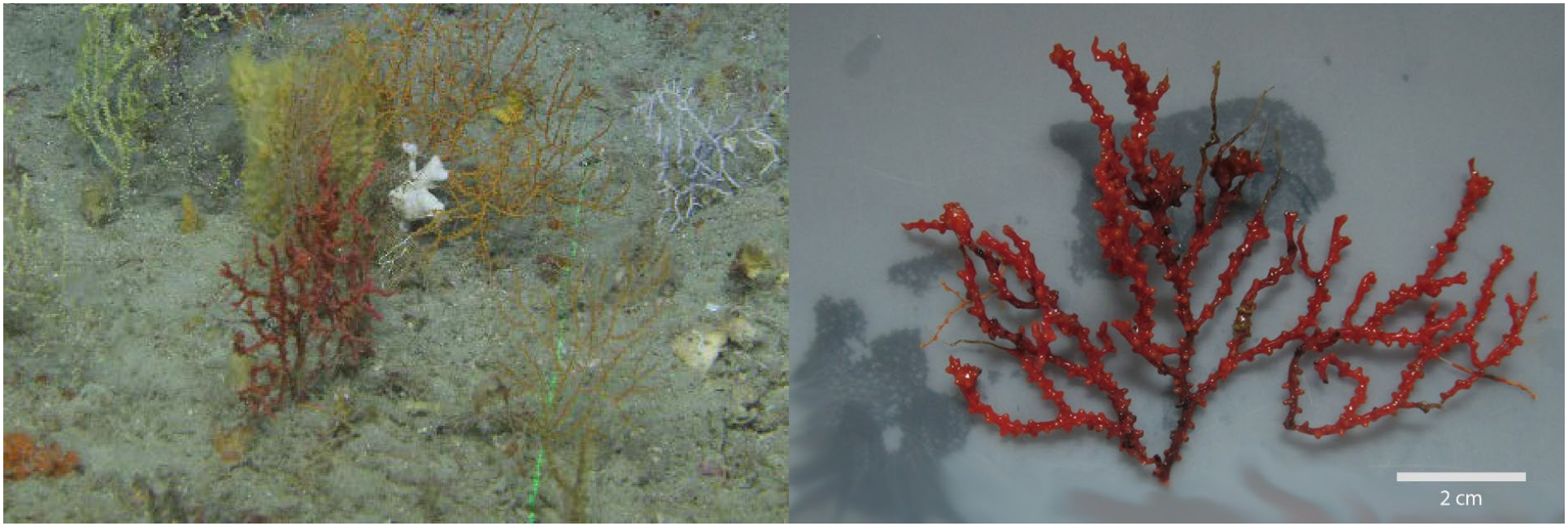
Placogorgia tenuis (Verrill, 1883)



Description (*cont.*): Individual species of *Placogorgia* are distinguished by a combination of the shape and size of the calicular thorn scales (left hand side of SEM plate), cortical spindles (top right of SEM plate), and opercular rods or sclerites (bottom right of SEM plate). *P. tenuis* is unique as it is the only species of *Placogorgia* with a crutch-shaped opercular rod. It is also characterized by having only a single spine on the cortical spindle (Deichmann, 1936; Bayer, 1959).

Remarks: This species shares a gross morphology with a large number of similar yellow plexaurids that are impossible to differentiate *in-situ*. Given the degree of uncertainty at even the genus level without sclerites, this species should not be diagnosed beyond the family level from *in-situ* footage.

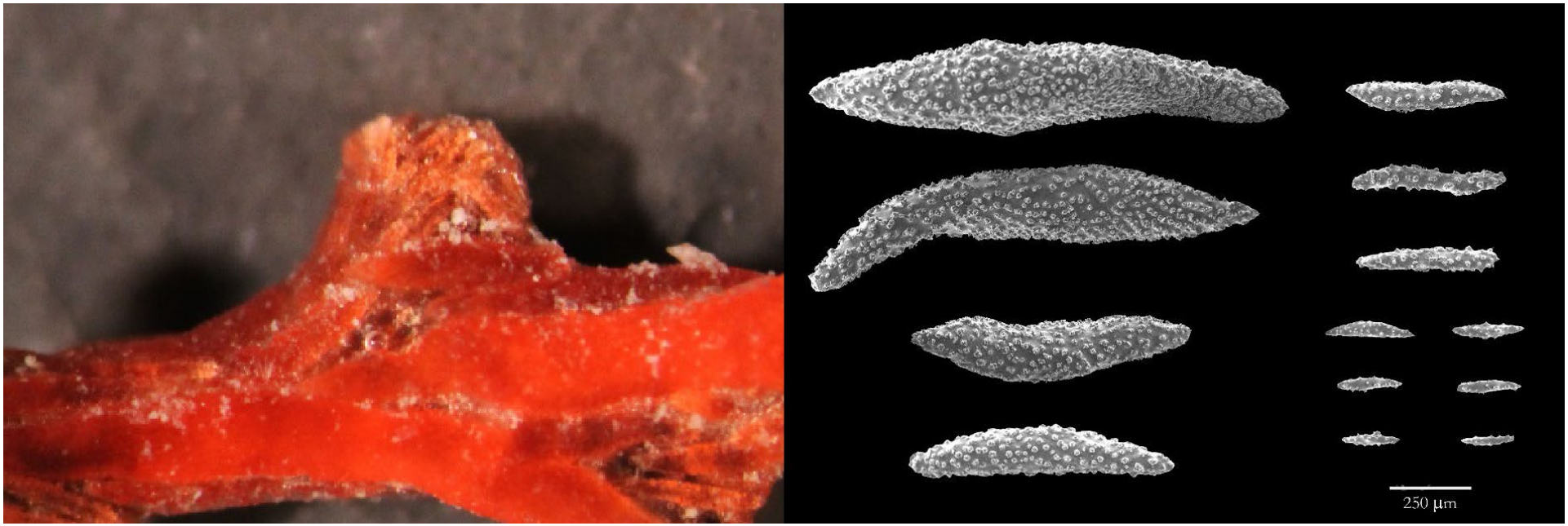
Scleracis guadalupensis (Duchassaing & Michelotti, 1860)



Distribution: This species has been documented in the northeast, northwest, and southeast Gulf of Mexico ranging from 51 - 262 meters (Etnoyer & Cairns, 2017), and in southeastern US waters (Cairns & Hourigan, 2017). It also occurs throughout the Caribbean and as far south as the coast of Brazil (NOAA DSCRTP, 2020)

Description: *Scleracis guadalupensis* forms small red-colored colonies less than 10 cm, branching dichotomously in one plane. The calyces are cylindrical, very prominent, about 1mm in height and biserially arranged along the sides of the branches, in a spiral pattern around the branch. Specimens appear red in ethanol, but pink, gray and white colonies have also been reported in ethanol (Deichmann, 1936; Devictor & Morton, 2010).

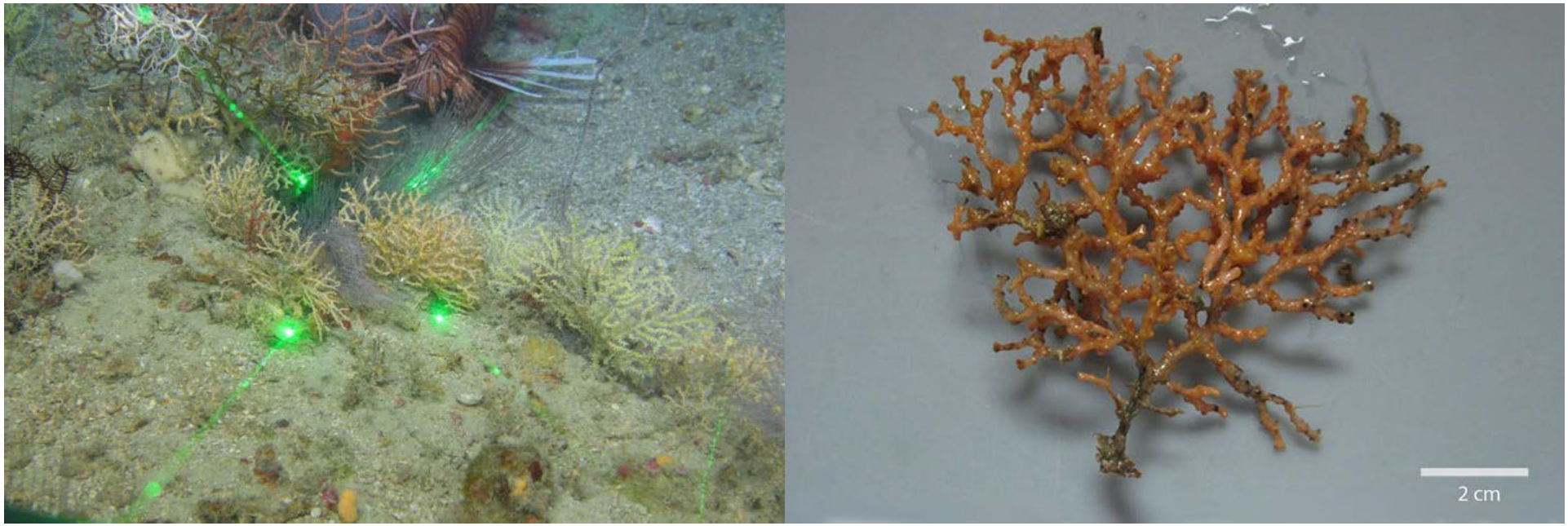
Scleracis guadalupensis (Duchassaing & Michelotti, 1860)



Description (*cont.*)**:** *S. guadalupensis* has rather indistinct sclerites consisting solely of varying sizes of spindles. Sclerites from the rim of the calyces are small warted spindles (bottom right of SEM plate), at the base of the calyx these spindles arelarge (1–3 mm) and extend into the coenenchyme(left and top right of SEM plate). The large spindles are oriented longitudinally along the axis and are densely scattered with fine, spinous warts, except near the acute tips (Deichmann, 1936; Devictor & Morton, 2010).

Remarks: Given its small size, *in-situ* identification of this taxon requires good lighting, high definition cameras, and close proximity to the seafloor. At a distance, *Thesea rubra* and other small red plexaurids could easily be mistaken for *S.guadalupensis*.

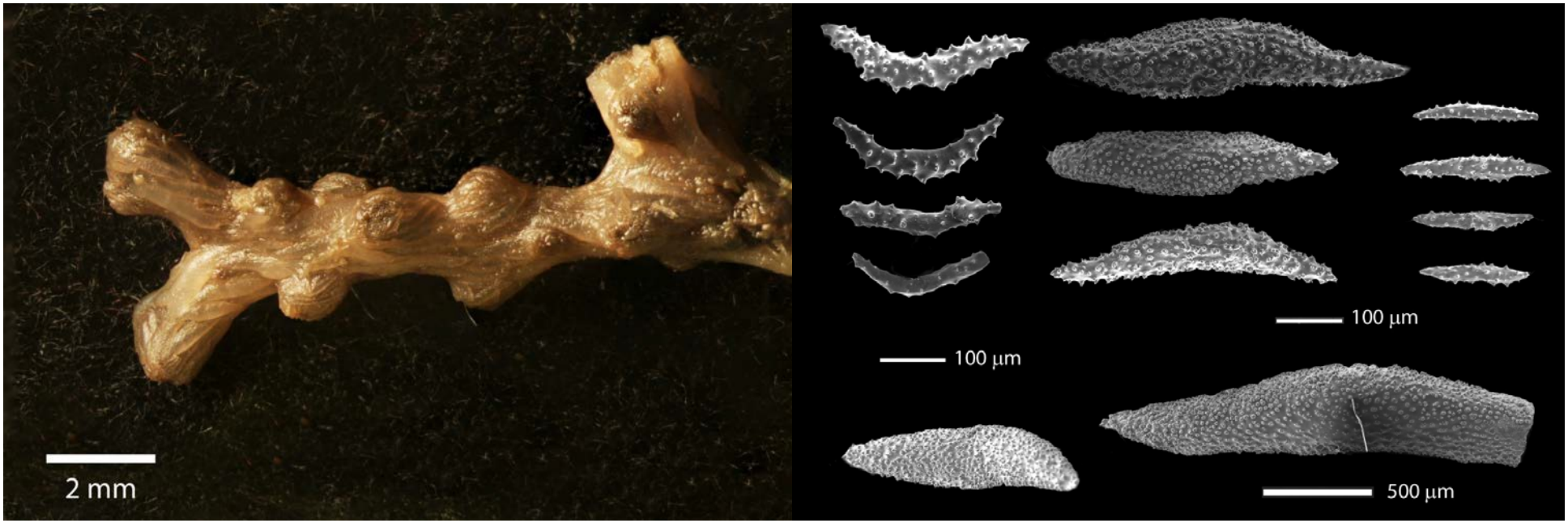
Scleracis sp.



Distribution: There are only two known species of *Scleracis*, *Scleracis guadalupensis* (51-262 m) and *S. pertosa* (62-1604 m). As previously noted *S. guadalupensis* is found in SEUS waters, thoughout the Caribbean and along the Atlantic Coast of South America as far south as Brazil. *S. pertosa* can also be found throughout Caribbean waters (NOAA DSCRTP, 2020). Morphologically this species does not appear to be either of these two species, so currently can only be attributed to the Gulf of Mexico.

Description: This morphotype is a small (~10 cm) yellow sea fans collected that highly resembled *Scleracis guadalupensis* in gross morphology except for color. This morphotype shares the very prominent cylindrical calyces which exhibit similar placement as *S.guadalupensis,* however, *S. guadalupensis* is only documented as being coral red, pink, gray or white (Deichmann, 1936; Devictor & Morton, 2010). These specimens were all yellow- yellowish brown *in-situ*, and many of the specimens collected that matched this description turned black in ethanol. *S.pertosa* follows is similar in gross morphology to *S. guadalupensis,* and is documented as being brown-yellowish brown, however there is difference in sclerite morphology (described on the next page) that rule out *S. pertosa*.

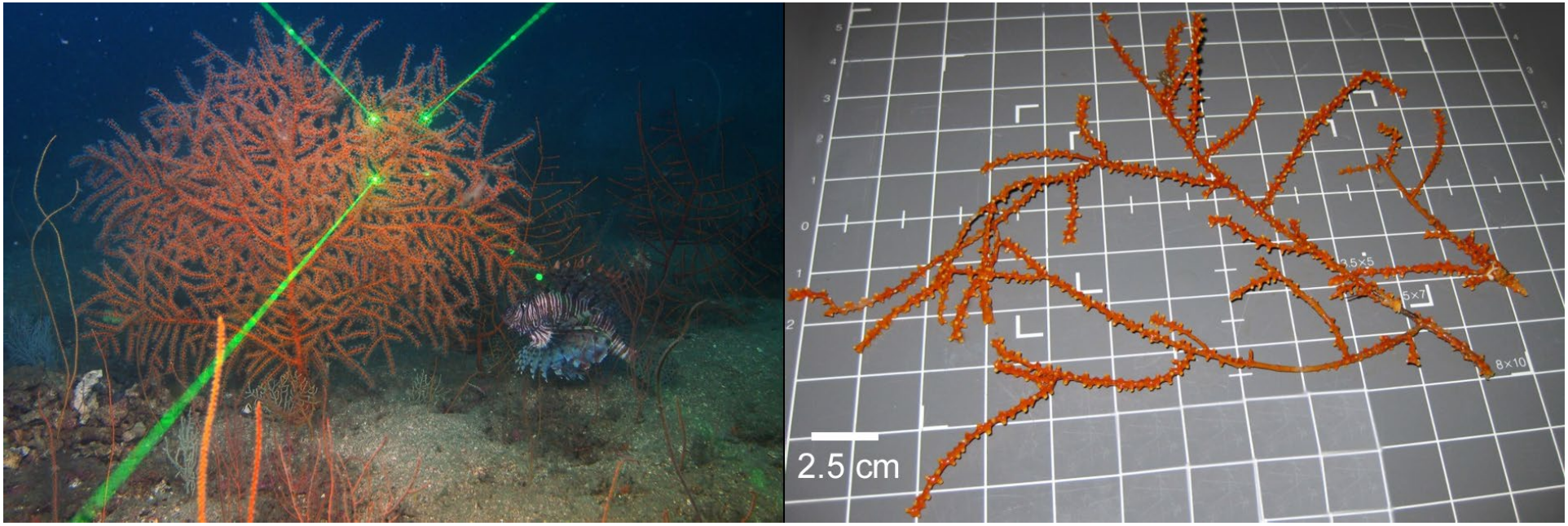
Scleracis sp.



Description (*cont.*): Presented above are the sclerites of this yellow morphotype of *Scleracis.* The sclerites from the rim of the calyces are curved small warted spindles (top left of SEM plate), which become larger and straighter towards the base (top center and top right of SEM plate) the spindles become large (1–3 mm) and extend into the coenenchyme just as they do in *S. guadalupensis*. The large spindles are also densely scattered with fine, spinous warts, except near the acute tips just like *S. guadalupensis* (bottom of SEM plate). However given the discrepancy in color and the curved spindles in the calyx this species could not be diagnosed as *S. guadalupensis*, it also does not match the description of the only other species of *Scleracis*, *S. pertosa,* which is described as having plates in the outer coenechyme not large spindles.

Remarks: This species could not be diagnosed beyond the genus level even with a thorough review of the sclerite morphology (see description). Given this, an *in-situ* diagnosis cannot go beyond this level either. Given its size and similarity in color and style of polyps, without high quality zoomed in shots even a genus level identification is suspect; a safer level of identification in most cases would be ‘small yellow Plexauridae’.

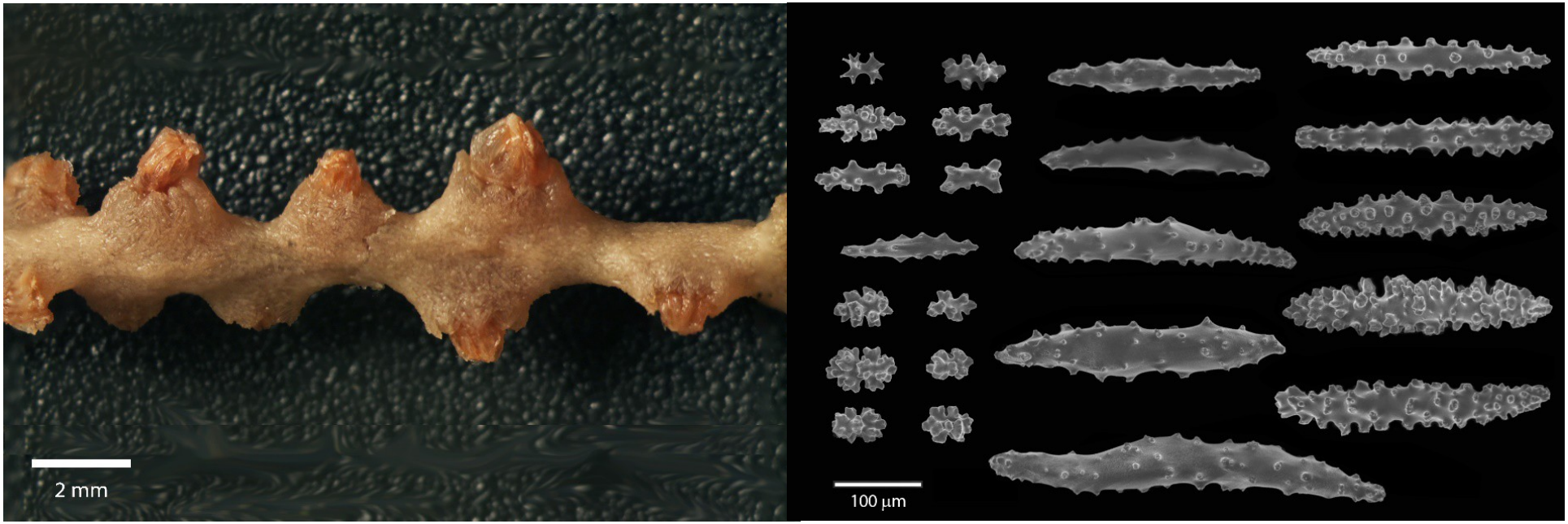
Swiftia exserta (Ellis & Solander, 1786)



Distribution: *Swiftia exserta* has a tropical West Atlantic distribution, it occurs in southeastern and Caribbean US waters (Cairns and Hourigan, 2017), from the Greater Antilles to the Meso-American Reef and the Yucatan Peninsula and as far south as Brazil (Goldberg, 2001; NOAA DSCRTP, 2020). This species has been documented in the northeast, northwest, and southeast Gulf of Mexico at a depth range from 21 - 494 meters (Etnoyer & Cairns, 2017).

Description: *Swiftia exserta* is a large (40-75 cm in height), loosely branched orange colored sea fan. Colonies can grow up to 80 cm across. The colonies typically branch in one plane but can appear bushy. Branches diverge at a perpendicular angle and exhibit large conical calyces that are non-retractile or 'exsert' (Deichmann, 1936). Branches are thin and calyces are arranged in a predominantly alternating configuration (Deichmann, 1936; Goldberg, 2001). While typically observed with a red or white color polyp outside of the Gulf of Mexico, within the Gulf of Mexico polyp color is typically white (sensu Etnoyer et al., 2016). The polyps have long pinnate tentacles that taper. Sclerites are colorless. The color of the colony readily extracts into water and ethanol or oxidizes rapidly if the specimen is dried (Goldberg, 2001).

Swiftia exserta (Ellis & Solander, 1786)



Description (*cont.*)**:** *S. exserta* is unique, differentiated from other species of *Swiftia* because it is the only species in the genus were the calyx is comprised predominantly of large spindles (center and right hand column of SEM plate) while the coenenchyme is composed predominantly of capstans and small rods (left hand column of SEM plate). It should be noted that the large spindles from the calyx are present in the outer coenenchyme as well but they are not prevalent (Goldberg, 2001).

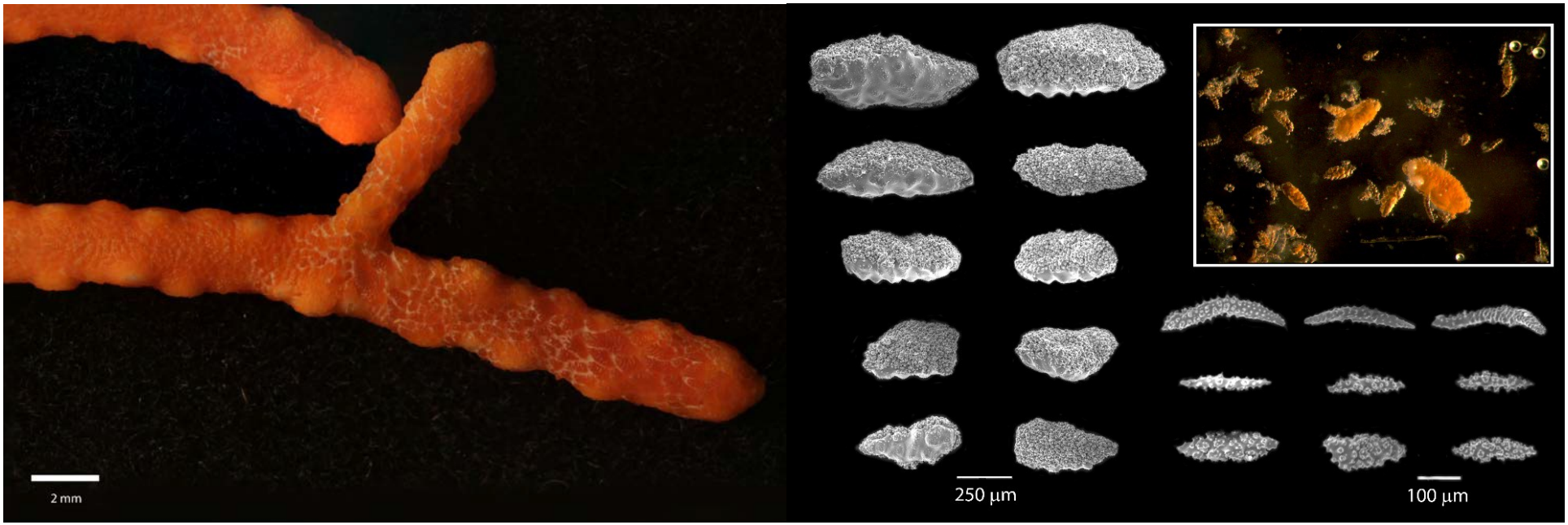
Remarks: *Swiftia exserta* has a distinctive appearance due to the loose, dichotomous perpendicular branching pattern and the prominent conical calyces. These colonies are hard to mistake for much else when proximity is obtained. *Leptogorgia* or other orange to red Plexauridae could appear similar at a distance. Therefore, a species-level identification can be made from *in-situ* footage.

Thesea citrina Deichmann, 1936

Distribution: This species has been documented in the northeast and southeast Gulf of Mexico from 79-159 meters (Etnoyer and Cairns, 2017). This species has not been documented in US waters outside of the Gulf of Mexico (Cairns and Hourigan, 2017). The type locality for this species is off the Dry Tortugas, and there are no documented instances off this species outside of the Gulf of Mexico (Deichmann, 1936)

Description: Small, typically around 10 cm, sea fan branching in one plane. Branches are long and slender with small upward turned branchlets (Deichmann, 1936). The color can vary from orange to yellow-brown. It should be noted that Deichmann's key for *Thesea* references the orange color of the sclerites and ultimately the colony, while her written description of the taxa references other possible colors including yellow and red. The texture of the colony is mostly smooth because of the small low circular calyces (Deichmann, 1936). Branches are only slightly laterally compressed.

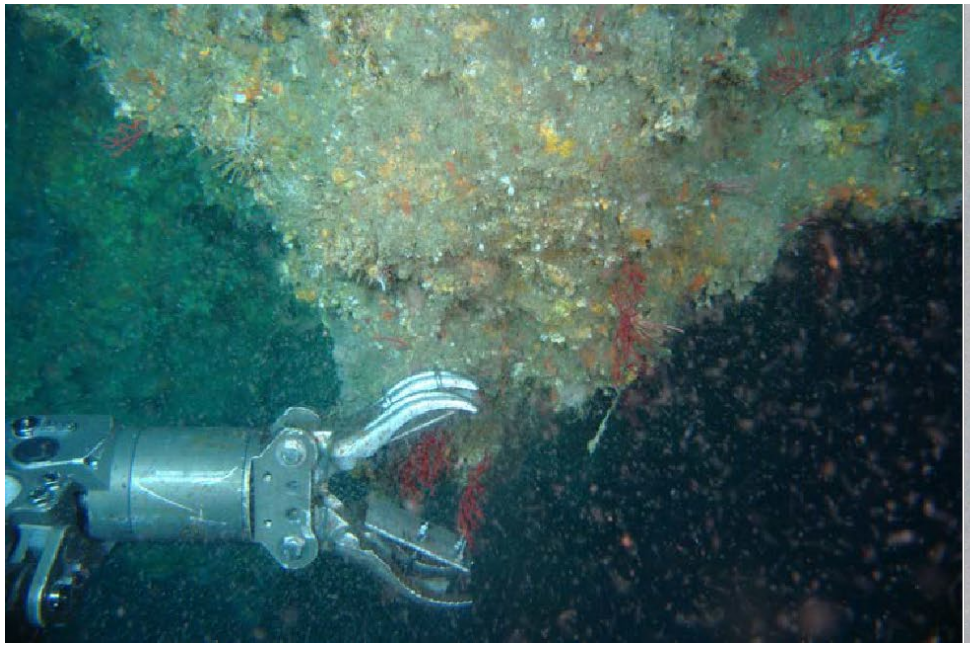
Thesea citrina Deichmann, 1936



Description (*cont.*): *T. citrina* is distinguished from other species of *Thesea* by having uniformly orange sclerites. Sclerites from the outer coenenchyme (color illustrated in top right inset of sclerite plate) are mostly large plate-like spindles, which are oblong and blunt (Left side of SEM plate). In the original species description, they are defined as being finely granulated on the surface and usually contain one longitudinal furrow and several transverse furrows which subdivide the surface indistinctly (this feature can be seen in the top left two sclerites). The inner coenenchyme is comprised of smaller spindles with girdles of spines (Deichmann, 1936). The sclerites around the calyces are of the same type as in the coenenchyme, but smaller.

Remarks: Given the low calyces, this species could be confused with a *Leptogorgia*, however, the slight lateral compression commonly observed in *Thesea* should be enough to differentiate the two *in-situ*. There is only one other species of orange *Thesea,* which is *T. rugosa,* but it is more sparsely branched and lacks the small upturned branchlets. A species-level identification from *in-situ* footage is acceptable given adequate proximity to the subject matter, otherwise, a genus or family level identification is more appropriate.

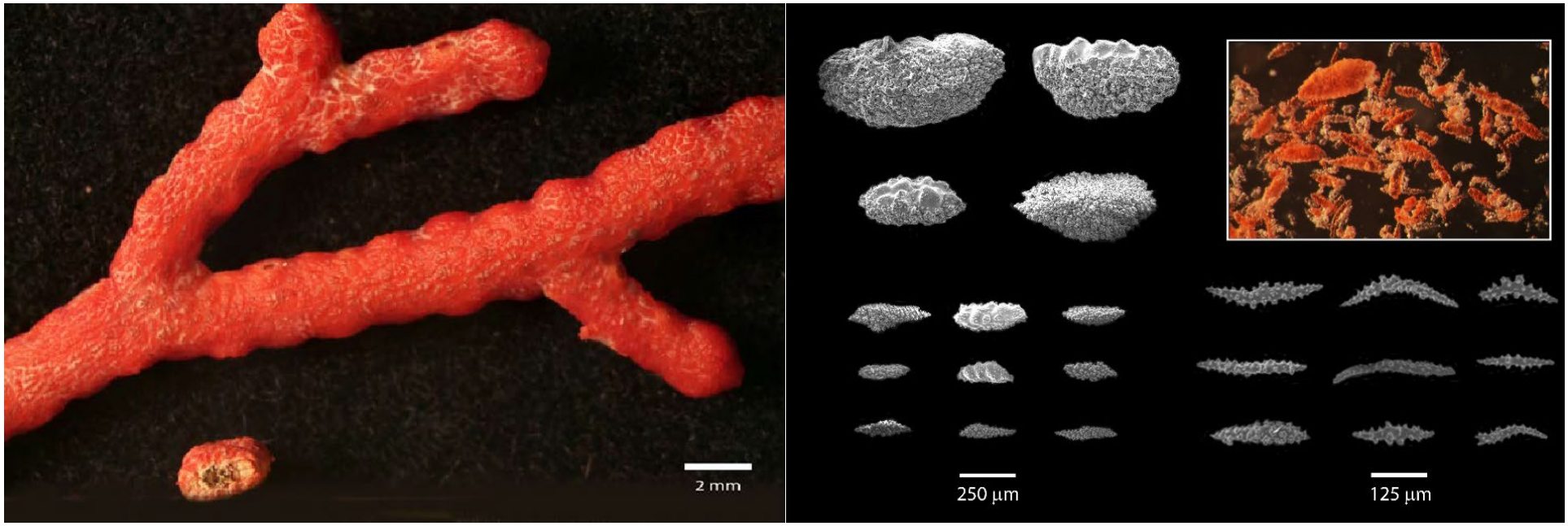
Thesea granulosa Deichmann, 1936



Distribution: This species has been documented in the northeast and northwest Gulf of Mexico ranging from 73-298 meters (Etnoyer and Cairns, 2017). This species has not been documented in US waters outside of the Gulf of Mexico (Cairns and Hourigan, 2017). The type locality for this species is off Carriacaou, Lesser Antilles, and there are other records of this species in the Lesser Antilles (Deichmann, 1936).

Description: This species is quite similar in gross morphology to *Thesea rubra*. It is a small red sea fan just over 10 cm in height. It branches profusely in one plane, with a large number of upward turned branchlets in alternating order. Calyces are conical and mostly laterally placed. Unlike *T. rubra* there is no thickening of the distal tips.

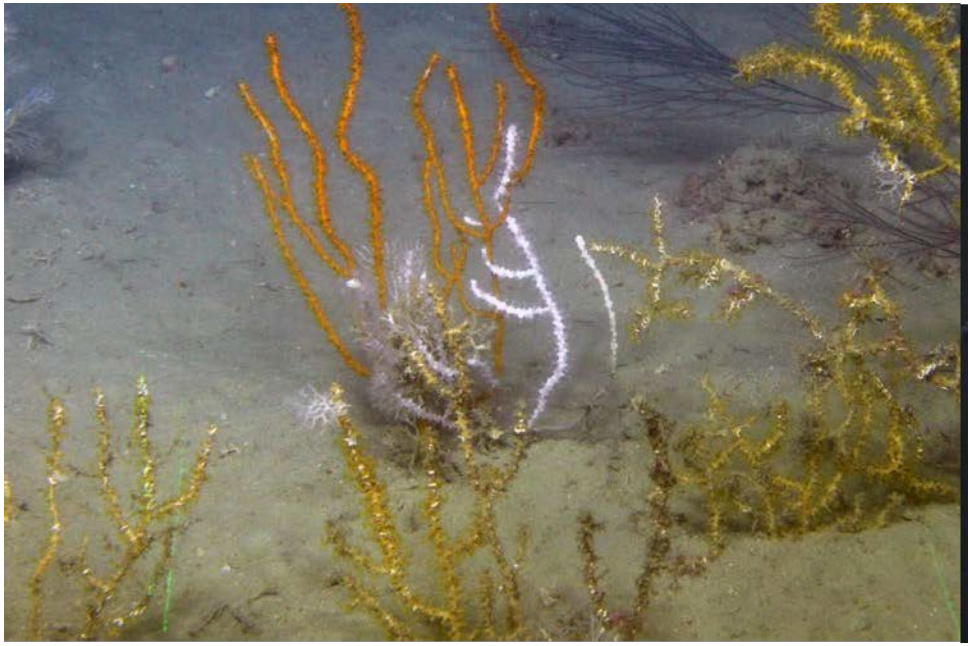
Thesea granulosa Deichmann, 1936



Description (*cont.*): *Thesea granulosa* is differentiated from other *Thesea* by the presence of red sclerites in both the outer and the inner coenenchyme (illustrated in the top right LM inset of the SEM plate). The outer coenenchymal sclerites are primarily double cones and large rounded oblong plates (top right of SEM plate), originally described by Deichmann (1936) as 'grains'. The inner coenenchymal sclerites are short bodies, double cones, and sparingly warted spindles (bottom right of SEM plate).

Remarks: This species could easily be mistaken for *Scleracis guadalupensis* or *Thesea rubra in-situ. T. granulosa* lacks the large cylindrical calyces present on *S. guadalupensis,* which given enough proximity to the coral *in-situ* may be observable. This species is primarily distinguishable from *T. rubra* via microscopy by the difference in coloration of the sclerites from the inner coenenchyme, but with proper proximity, the two can be differentiated by a lack of thickening at the distal tips which is indicative of *T. rubra*. A species-level identification from *in-situ* footage is acceptable given adequate proximity to the subject matter, otherwise, a genus or family level identification is more appropriate.

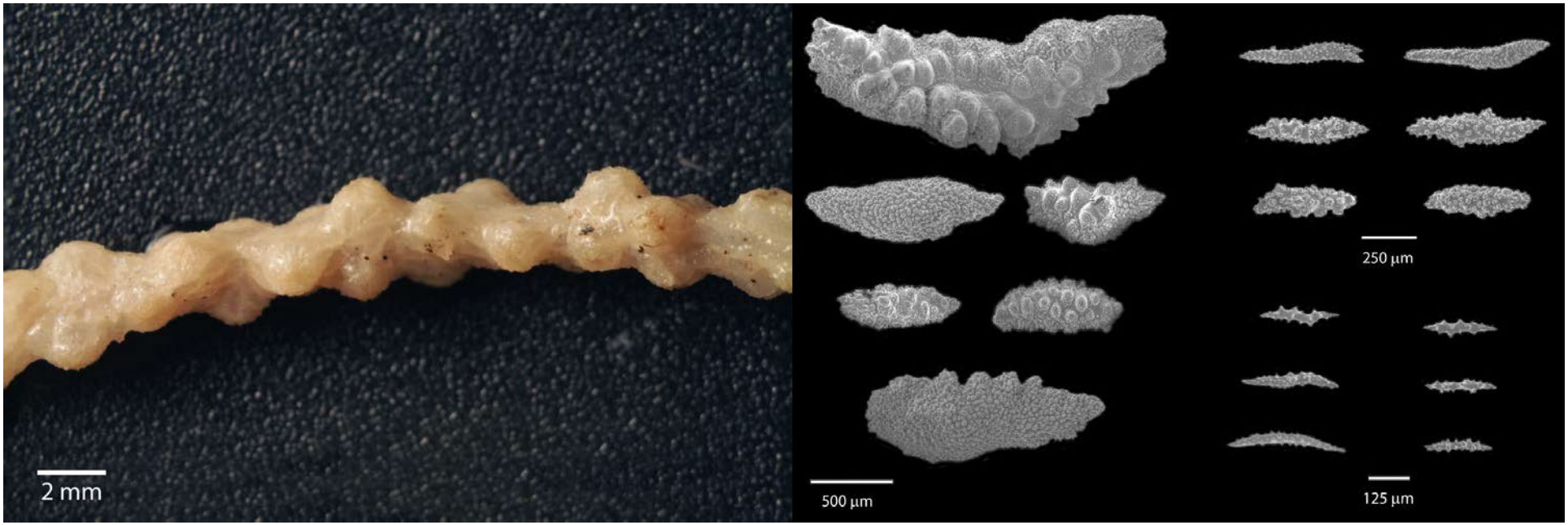
Thesea guadalupensis Duchassaing & Michelotti, 1864



Distribution: This species has been documented in the northeast and northwest Gulf of Mexico and a depth range of 81-159 meters (Etnoyer & Cairns, 2017). This species has not been documented in US waters outside of the Gulf of Mexico (Cairns & Hourigan, 2017). The type locality for this species is off Guadaloupe, there are also records of it being present off St Vincent and Grenadines (Deichmann, 1936).

Description: This species is a small sparsely branched white sea fan with long branches that can get as tall as 20 cm. Branches are 2 mm in thickness typically, with distinct conical calyces that are uniformly distributed (Deichmann, 1936).

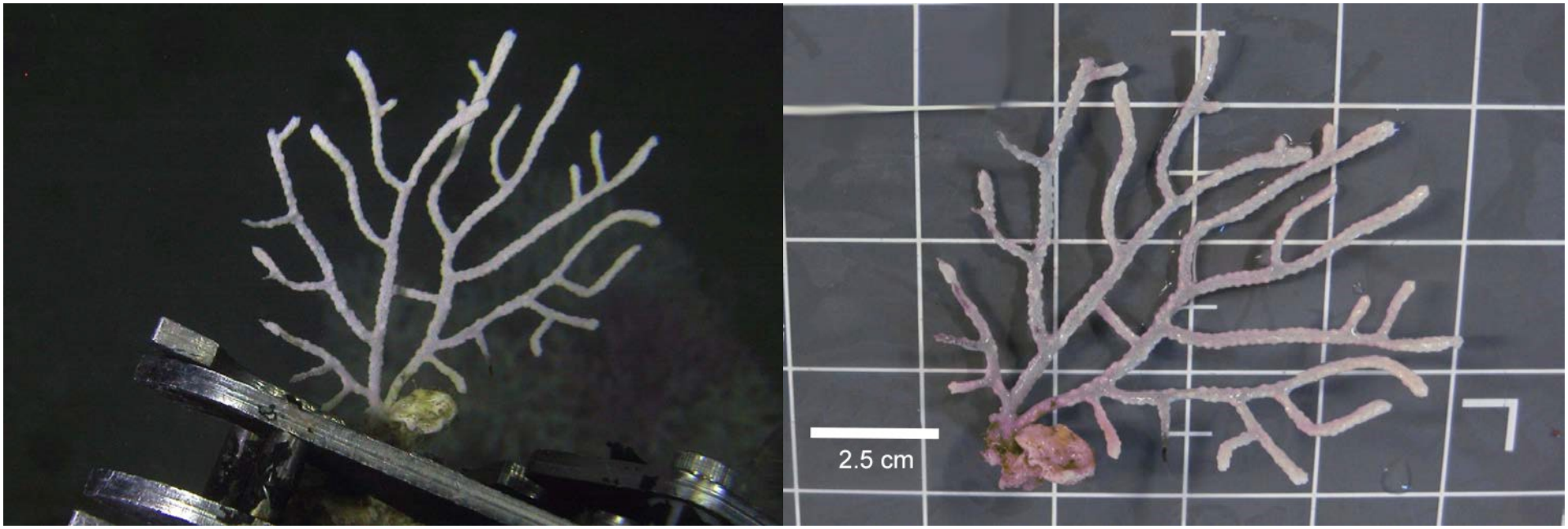
Thesea guadalupensis Duchassaing & Michelotti, 1864



Description (*cont.*): Sclerites are exclusively white and comprised of oblong plates with transverse ridges on the outer side and tubercles on the inner side (left side of SEM plates). The inner coenenchyme is comprised of small spindles with scattered warts (right side of SEM plates) (Deichmann, 1936).

Remarks: Of the white species of *Thesea, T guadalupensis* is easily recognizable from the branching pattern and conical calyces. A species level identification can be achieved *in-situ*, given close proximity to the octocoral.

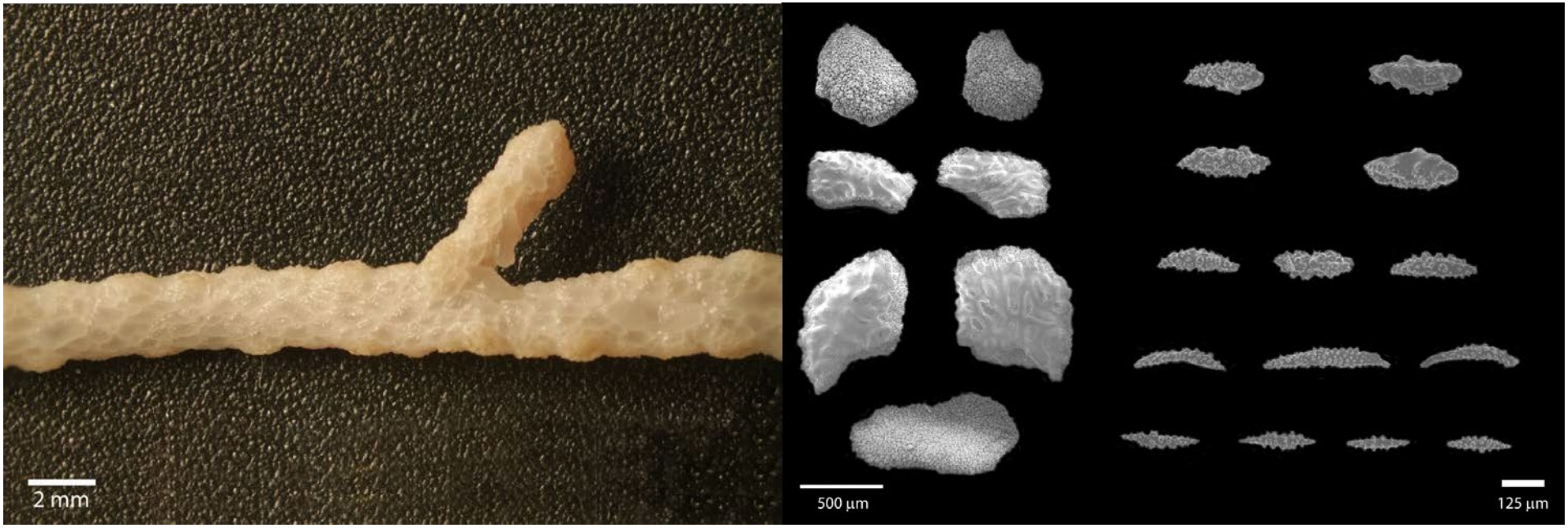
Thesea hebes Deichmann, 1936



Distribution: This species has been documented in the northeast and southeast Gulf of Mexico and a depth range of 78-377 meters (Etnoyer & Cairns, 2017). This species has not been documented in US waters outside of the Gulf of Mexico (Cairns & Hourigan, 2017). The type locality is off St. Vincent, and there are other records through the northern and eastern Caribbean (Deichmann, 1936).

Description: This species is a small white sea fan ranging in height from 6-20 cm. Branches are 3 mm in thickness typically, with low conical calyces that crowd at the edges. Tissue of the coenenchyme can take on a gray hue, but colonies are typically white.

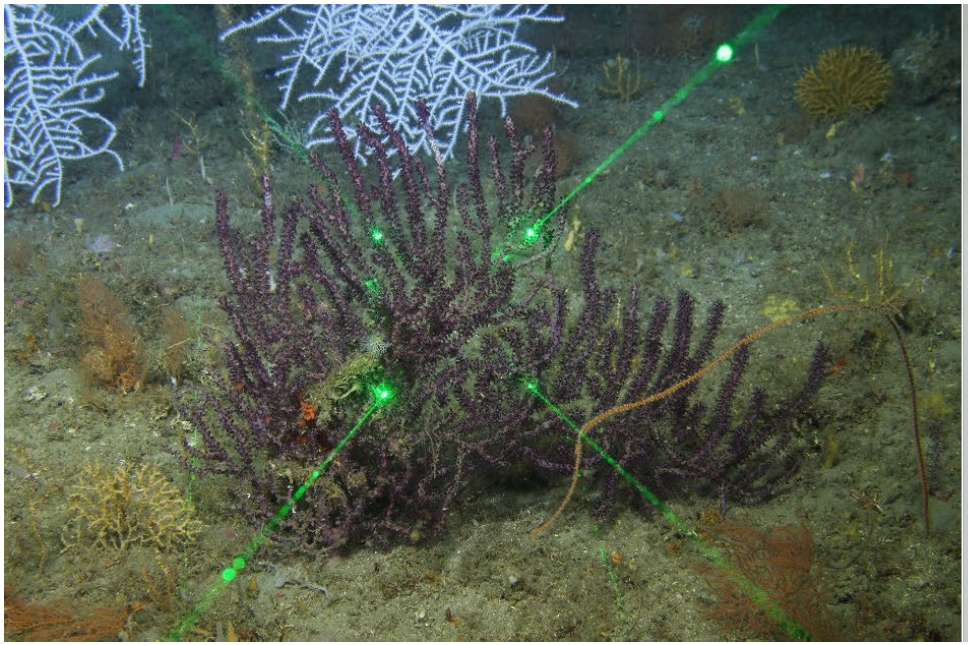
Thesea hebes Deichmann, 1936



Description (*cont.*): Sclerites are exclusively white and comprised of loosely fit plates in the outer coenenchyme (left isde of SEM plate) with small spindles present in the calyces and inner coenenchyme (right side of SEM plate). The double cones common among other similar species are scarcely present (Deichmann, 1936).

Remarks: Currently the best available description and key for the genus *Thesea* is that presented by Deichmann (1936), which relies heavily on color. There are several species of *Thesea* that are white. Of those *T. hebes* is easily differentiated from most by colony shape, but could possibly be mistaken for *Thesea parviflora in-situ*. While, the most reliable means to differentiate these two is reviewing the sclerites, and confirming the absence of the double cones, the grey color of the coenechyme and polyp placement at the edges are enough to adequately differentiate the two species.

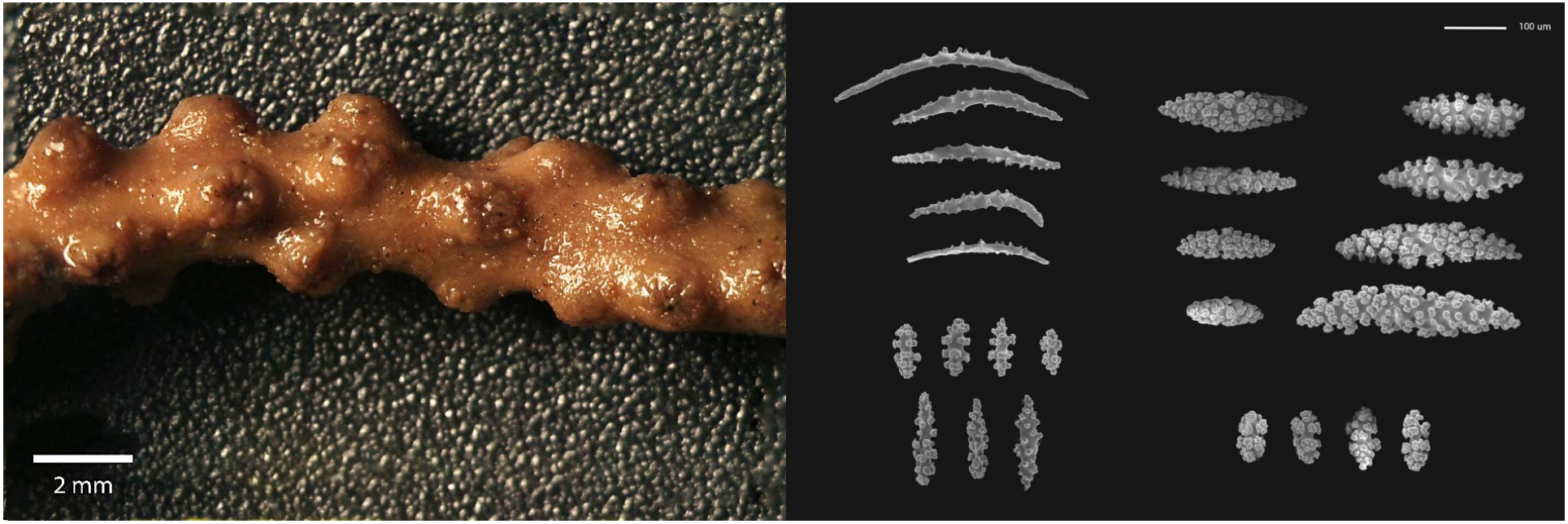
Thesea nivea Deichmann, 1936



Distribution: This species has been documented in the northeast and northwest, as well as the southeast, Gulf of Mexico ranging from 63-120 meters (Etnoyer & Cairns, 2017). This species has also been documented in SEUS waters (Devictor & Morton, 2010). The type locality is in the Caribbean off Guadeloupe suggesting it also has a potential distribution through Caribbean waters as well (Deichmann, 1936).

Description: This species branches more or less in one plane and is sparingly branched. Branches are long and upward bent with low broad conical calyces. The color of the colony is originally described as pure white but has been reported to vary in color both *in-situ* and preserved (Deichmann, 1936). *In-situ* has been reported to vary from purple to red, with a pale to white axis (Devictor & Morton, 2010). Preserved the coenenchyme can take on a brown, gray, or creamy white color (Deichmann, 1936).

Thesea nivea Deichmann, 1936



Description (*cont.*): Sclerites are white and consist of large, warty, acute spindles (top right of SEM plate) and small double heads (bottom right of SEM plate), and some spiny or warty curved rods (top left of SEM plate). The curved rods are from the anthocodia, while the spindles and double heads are from the outer coenenchyme of both the calyx and axis. The inner coenenchyme contains simple spindles with scattered warts (bottom left of SEM plates) (Deichmann, 1936; Devictor & Morton, 2010).

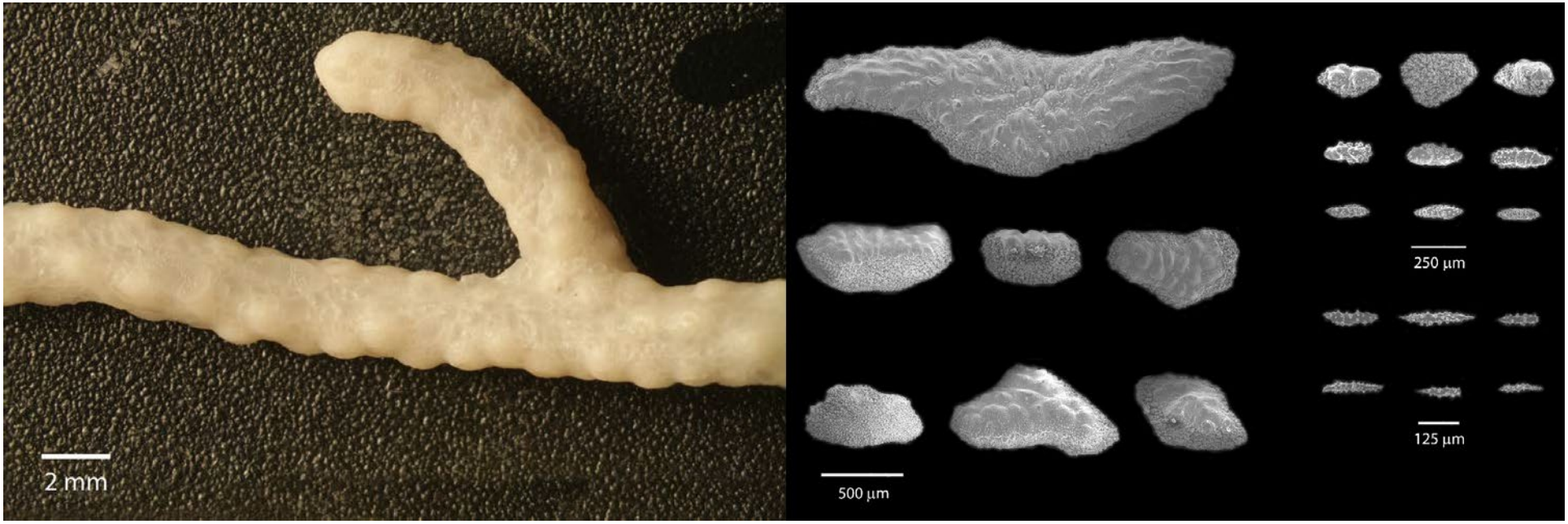
Remarks: This species lacks the diagnostic characteristic of the genus in which it is placed, and as such work to properly define this species' proper placement is required. Though when taken as currently described, inexperienced taxonomists may mistake it for *Placogorgia* or *Paramuricea in-situ*, but once familiar with the species it is difficult to mistake it for much else. A species-level identification from *in-situ* footage can be achieved with close proximity to the subject matter.

Thesea parviflora Deichmann, 1936

Distribution: This species has been documented in the northwest and southeast Gulf of Mexico and a depth range of 62-216 meters (Etnoyer & Cairns, 2017). This species has been documented in SEUS waters (NOAA DSCRTP, 2020). The type locality for this specimen is off Dominica Island, and there other records off Cuba and in the Lesser Antilles (Deichmann, 1936).

Description: This species is a small white sea fan, with the type specimen only measuring 14 cm in height. Branches are thin 1 mm in thickness typically, with low calyces hardly raised above the surface of the axis (Deichmann, 1936).

Thesea parviflora Deichmann, 1936



Description (*cont.*): Sclerites are exclusively white and comprised of round ended oblong plates, with a smooth embossed outer side and tubercles on the inner side, in the outer coenenchyme (Left side of SEM plate). The inner coenenchyme is comprised of small spindles (right side of SEM plate) (Deichmann, 1936).

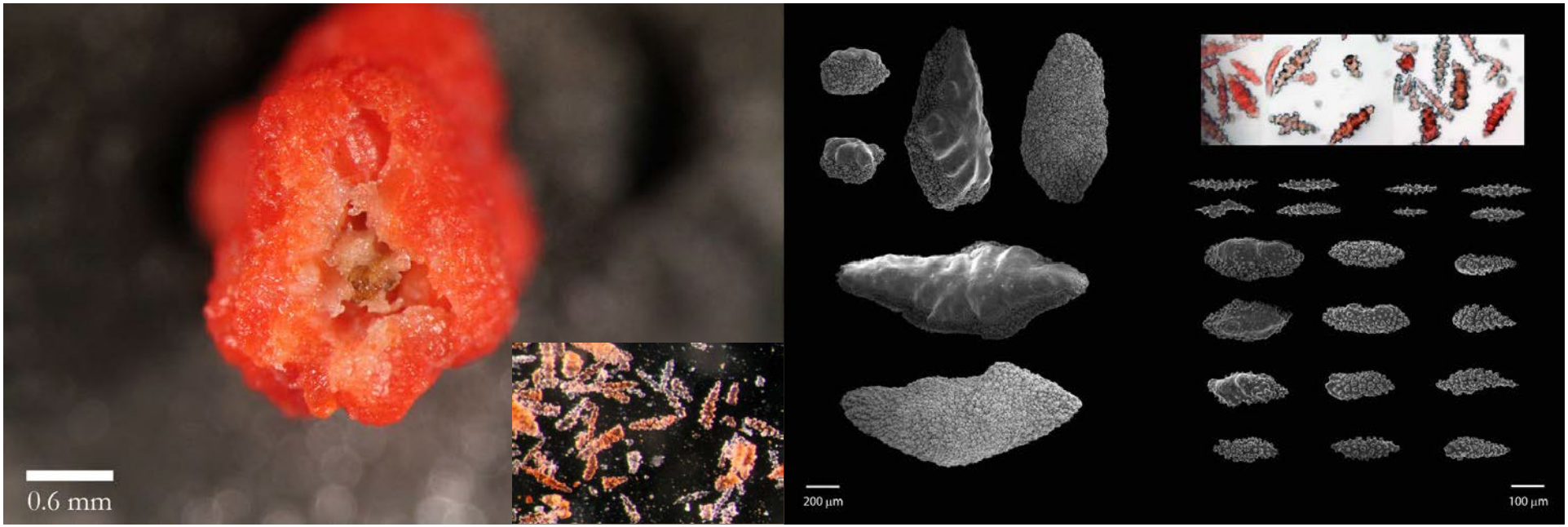
Remarks: This species looks remarkably like a white *T. rubra;* however there is subtle variation in the sclerites and thus further genetic work is certainly recommended. However, as currently accepted, this species is unique in appearance to warrant a species level identification *in-situ*.

Thesea rubra Deichmann, 1936

Distribution: This species has been documented in the northeast and northwest Gulf of Mexico ranging from 64-837 meters (Etnoyer & Cairns, 2017). This species has not been documented in US waters outside of the Gulf of Mexico (Cairns & Hourigan, 2017). However, the type location is in the Caribbean sea off Carriacou Island (Deichmann, 1936).

Description: *T. rubra* is a small red fan (10-20 cm), with white polyps along the lateral edges of flattened branches that thicken at the distal tip. Colonies are densely branched in one plane with branches laterally compressed. Low warty calyces are placed laterally. Colonies are red, due to the color of the large granular sclerites in the outer coenenchyme, which results in a finely granular surface (Deichmann, 1936).

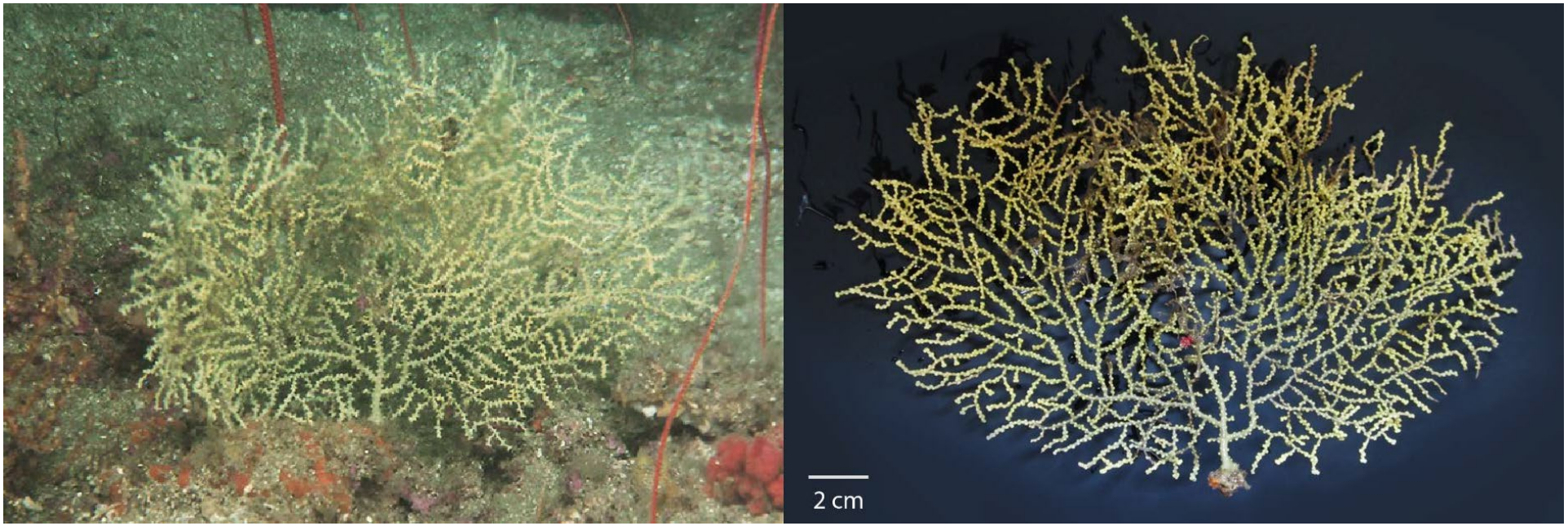
Thesea rubra Deichmann, 1936



Description (*cont.*): *Thesea rubra* is differentiated from other *Thesea* by the presence of red sclerites in the outer coenenchyme, and white sclerites in the inner coenenchyme (sclerite color illustrated in the bottom right of the LM axis cross section and the upper right of the SEM plate). The outer coenenchymal sclerites are primarily double cones and large rounded oblong plates (left side of the SEM plate), while the inner coenenchymal sclerites are short bodies, double cones, and sparingly warted spindles (right side of the SEM plate) (Deichmann, 1936).

Remarks: Two species could easily be confused as *T. rubra*. *Scleracis guadalupensis is* distinguished from *T. rubra* by the large cylindrical calyces and uniform thickness of branches. *Thesea granulosa is* distinguishable via microscopy by difference in sclerite coloration, but also lacks the thickening at the distal tips. A species-level identification from *in-situ* footage is possible given adequate proximity to the subject matter, otherwise, a genus or family level identification is more appropriate.

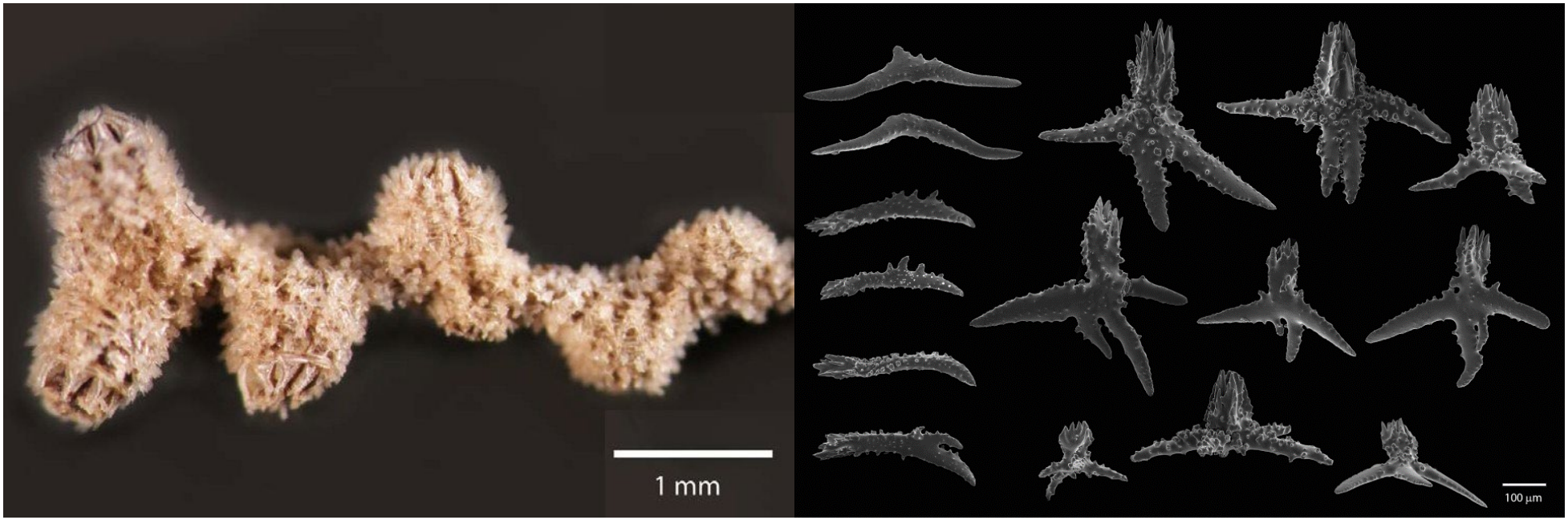
Villogorgia nigrescens Duchassaing & Michelotti, 1860



Distribution: This species has been documented in the northeast and southeast, Gulf of Mexico at depths from 58-478 meters (Etnoyer & Cairns, 2017). This species has been documented in US waters in the SEUS and throughout the Caribbean from the Yucatan peninsula to the Lesser Antilles (Cairns & Hourigan, 2017; NOAA DSCRTP, 2020).

Description: *Villogorgia nigrescens* is a small sea fan that varies in color from white- to off-white or pale yellow. It branches profusely, in one plane. The branches and branchlets are thin, about 1 mm or less in diameter and the polyps are laterally placed. Most colonies are about 10 cm (Deichmann, 1936), though larger colonies have been observed up to 20 cm. *Villogorgia* colonies are equally wide as they are tall (Deichmann, 1936). The distal tips contain two polyps perpendicular to the axis that form a “T” shape (A. Shuler, pers. obs.).

Villogorgia nigrescens Duchassaing & Michelotti, 1860



Description (*cont.*): The diagnostic sclerite shape of *Villogorgia nigrescens* is similar to the thorn scales of *Placogorgia* and *Paramuricea*, however, instead of a true thornscale, it is rather a four-arm radiate with a foliate thorn (right side of SEM plate). Both the cortical and calicular sclerites are dominated by these foliate thorned four-arm radiates (Bayer, 1959).

Remarks: Given its small size and white color, a number of small white Plexauridae could be misidentified as *Villogorgia*. A species-level identification requires microscopic review of the sclerites. From *in-situ* imagery alone, a genus-level identification is ill-advised. The most accurate and useful identification would be 'small, densely branched, white Plexauridae'.

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Appendix:

Table 1. List of species presented and the USNM catalog number or sample ID, for all samples reviewed to generate the identifications. Catalog or sample ID numbers in bold are whose images are presented in this guide. The superscripts denote which images were derived from that specific specimen. a= *in-situ* image, b = *ex-situ* image, c = light micrograph of the axis and polyps, d = scanning electron micrograph plate of the sclerite morphology.

Bebryce cinerea (pg 7, 8)
USNM 1579070, USNM 1583129, **USNM 1583232**[a,b], USNM 1583235, USNM 1583242, USNM 1583268, **USNM 1578926**[c,d], USNM 1583160

Bebryce grandis (pg. 9, 10)
USNM 1583145, USNM 1583204, USNM 1583240, **USNM 1583241**[a,b], USNM 1583257, **USNM 1583077**[c,d]

Carijoa riisei (pg. 11, 12)
USNM 1583000[a,b,c,d]

Ellisella elongata (pg. 13, 14)
DFH33_539B[c,d], **USNM 1583033**[b],*_in-situ_ image a representative image taken during NRDA survey work.

Leptogorgia violacea (pg. 15, 16)
USNM 1437435, USNM 1437436, USNM 1437437, USNM 1437438, USNM 1437439, USNM 1437440, **USNM 1437441**[a,b,c,d], USNM 1437442, USNM 1437443, USNM 1437444

Muricea pendula (White Variant) (pg 17, 18)
USNM 1578923, USNM 1578930, USNM 1583192, USNM 1583108, USNM 1583131, **USNM 1583150**[a,b,c,d], USNM 1583152, USNM 1583153, USNM 1583190, USNM 1583201, USNM 1583211, USNM 1583151

Murceides hirta (pg. 19, 20)
USNM 1583261 [a,b,c,d]

Nicella americana (pg. 21, 22)
USNM 1583097, **USNM 1583233**[a,b,c,d]

Nicella sp. (pg. 23, 24)
USNM 1583236[a,b,c,d]

Paramuricea sp. (pg. 25, 26)
USNM 1583130, USNM 1583134, USNM 1583146, USNM 1583219, USNM 1578932, USNM 1583262, USNM 1578988, **USNM 1579052**[a,b,c,d]

Placogorgia rudis (pg. 27, 28)
USNM 1578931, USNM 1583140, USNM 1583132, USNM 1583133, USNM 1583198, USNM 1583214,USNM 1583216, USNM 1583217, USNM 1583220, USNM 1583221, USNM 1583222, USNM 1583224, USNM 1578933, USNM 1583259, **USNM 1583260**[a,b,c,d], USNM 1578935, USNM 1578936

Placogorgia tenuis (pg. 29, 30)
USNM 1583267[a,b,c,d]

Scleracis guadalupensis (pg. 31, 32)
USNM 1583041[a,b,c,d]

Scleracis sp. (pg. 33, 34)
USNM 1583100, USNM 1583141, USNM 1583147, USNM 1583161, USNM 1583203, USNM 1583229, USNM 1583234, USNM 1583238, USNM 1579049, **USNM 1583284**[a,b,c,d], USNM 1583286

Swiftia exserta (pg. 35, 36)
USNM 1578927, USNM 1583029, USNM 1583030, USNM 1583036, **USNM 1578929**[a,b], **USNM 1583053**[c,d], USNM 1583156, USNM 1583157, USNM 1583158, USNM 1583187, USNM 1583189, USNM 1583194, USNM 1583210, USNM 1579125, USNM 1579126, USNM 1578996

Thesea citrina (pg. 37, 38)
USNM 1583205[a,b,c,d]

Thesea granulosa (pg. 39, 40)
USNM 1583148[a,b,c,d]

Thesea guadalupensis (pg. 41, 42)
USNM 1579047[a,b,c,d]

Thesea hebes (pg. 43, 44)
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Thesea nivea (pg. 45, 46)
USNM 1583026, USNM 1578925, USNM 1578928, USNM 1583086, USNM 1583196, USNM 1583197, USNM 1583200, **USNM 1583208**[a,b,c,d], USNM 1579048

Thesea parviflora (pg. 47, 48)
USNM 1583277[a,b,c,d]

Thesea rubra (pg. 49, 50)

HBOI 19-V-15-1-001[c] USNM 1578910, USNM 1582993, USNM 1578921, USNM 1583142, USNM 1583143, USNM 1583269, **USNM 1583271**[b,d], USNM 1583279, **in-situ* image provided courtesy of Flower Garden Banks National Marine Sanctuary.

Villogorgia nigrescens (pg. 51, 52)

USNM 1583047, USNM 1583135, USNM 1583149, USNM 1583159, USNM 1583228, USNM 1583230, **USNM 1583265**[a,b,c,d], USNM 1583266, USNM 1583274

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