

A Photographic Guide to the Benthic Flora and Fauna from Mesophotic Coral Ecosystems in the Papahānaumokuākea Marine National Monument



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
Office of National Marine Sanctuaries



PAPAHĀNAUMOKUĀKEA
Marine National Monument

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Cover Photo:

A mesophotic coral ecosystem dominated by the green macroalga *Microdictyon setchellianum* off Pearl and Hermes Atoll at 90 m depth in the Papahānumokuākea Marine National Monument (Credit: Greg McFall/NOAA).





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Table of Contents

Acknowledgements.....	vii
Executive Summary	viii
Chapter 1: Introduction.....	1
Chapter 2: Materials and Methods.....	3
Chapter 3: Results and Discussion	6
3.1 Cyanobacteria	7
3.1.1 Order <i>Oscillatoriales</i>	7
3.1.1.1 Family Oscillatoriaceae	7
3.2 Green Macroalgae	8
3.2.1 Order <i>Bryopsidales</i>	8
3.2.1.1 Family Bryopsidaceae	8
3.2.1.2 Family Caulerpaceae	9
3.2.1.3 Family Codiaceae	11
3.2.1.4 Family Halimedaceae	14
3.2.1.5 Family Udoteaceae	16
3.2.2 Order <i>Cladophorales</i>	17
3.2.2.1 Family Anadyomenaceae.....	17
3.2.2.2 Family Cladophoraceae	17
3.2.3 Order <i>Siphonocladales</i>	18
3.2.3.1 Family Siphonocladaceae	18
3.2.4 Order <i>Ulvales</i>	19
3.2.4.1 Family Ulvaceae	19
3.3 Red Macroalgae.....	20
3.3.1 Order <i>Acrosymphytales</i>	20
3.3.1.1 Family Acrosymphytaceae	20
3.3.2 Order <i>Bonnemaisoniales</i>	20
3.3.2.1 Family Bonnemaisoniaceae.....	20
3.3.2.2 Family Naccariaceae.....	21
3.3.3 Order <i>Ceramiales</i>	21
3.3.3.1 Family Dasyaceae.....	21
3.3.3.2 Family Delesseriaceae	23
3.3.3.3 Family Rhodomelaceae	24
3.3.4 Order <i>Gigartinales</i>	26
3.3.4.1 Family Chondrymeniaceae	26
3.3.4.2 Family Dumontiaceae.....	26
3.3.4.3 Family Kallymeniaceae	27
3.3.4.4 Family Rhizophyllidaceae	28
3.3.5 Order <i>Nemaliales</i>	28
3.3.5.1 Family Galaxauraceae	28
3.3.5.2 Family Scinaiaceae	29
3.3.6 Order <i>Halymeniales</i>	29
3.3.6.1 Family Halymeniaceae	29
3.3.7 Order <i>Nemastomatales</i>	30

3.3.7.1 Family Nemastomataceae.....	30
3.3.8 Order Peyssonneliales.....	30
3.3.8.1 Family Peyssonneliaceae.....	30
3.3.9 Order Plocamiales.....	31
3.3.9.1 Family Plocamiaceae.....	31
3.3.10 Unidentified Red Macroalgae.....	31
3.4 Brown Macroalgae.....	37
3.4.1 Order Dictyotales.....	37
3.4.1.1 Family Dictyotaceae.....	37
3.4.2 Order Ectocarpales.....	41
3.4.2.1 Family Acinetosporaceae.....	41
3.4.3 Order Fucales.....	41
3.4.3.1 Family Sargassaceae.....	41
3.4.4 Order Sporochneales.....	42
3.4.4.1 Family Sporochneaceae.....	42
3.5 Seagrasses.....	43
3.5.1 Order Alismatales.....	43
3.5.1.1 Family Hydrocharitaceae.....	43
3.6 Sponges.....	43
3.6.1 Calcareous Sponges.....	43
3.6.2 Demosponges, Order Agelasida.....	44
3.6.2.1 Family Hymerhabdiidae.....	44
3.6.3 Demosponges, Order Axinellida.....	44
3.6.3.1 Family Axinellidae.....	44
3.6.4 Demosponges, Order Chondrosiida.....	45
3.6.4.1 Family Chondrosiidae.....	45
3.6.5 Demosponges, Order Clionaida.....	46
3.6.5.1 Family Clionaidae.....	46
3.6.6 Demosponges, Order Haplosclerida.....	46
3.6.6.1 Family Callyspongiidae.....	46
3.6.7 Demosponges, Order Poecilosclerida.....	48
3.6.7.1 Family Chondropsidae.....	48
3.6.7.2 Family Esperipsidae.....	49
3.6.7.3 Family Tedaniidae.....	50
3.6.8 Demosponges, Order Scopalinida.....	51
3.6.8.1 Family Scopalinidae.....	51
3.6.9 Demosponges, Order Suberitida.....	51
3.6.9.1 Family Halichondriidae.....	51
3.7 Polychaetes.....	52
3.7.1 Order Sabellida.....	52
3.7.1.1 Family Sabellidae.....	52
3.8 Bryozoans.....	53
3.8.1 Order Cheilostomatida.....	53
3.8.1.1 Family Myriaporidae.....	53
3.8.1.2 Family Phidoloporidae.....	53
3.8.1.3 Family Steginoporellidae.....	54
3.8.2 Order Cyclostomatida.....	55
3.8.2.1 Family Crisinidae.....	55
3.8.3 Unidentified Bryozoans.....	55
3.9 Hydroids.....	56
3.9.1 Order Anthoathecata.....	56
3.9.1.1 Family Solanderiidae.....	56
3.9.2 Order Leptothecata.....	57
3.9.2.1 Family Aglaopheniidae.....	57



3.9.2.2 Family Campanulariidae.....	58
3.9.2.3 Family Sertulariidae	59
3.9.3 Unidentified Hydroids.....	59
3.10 Octocorals	60
3.10.1 Order Alcyonacea	60
3.10.1.1 Family Alcyoniidae	60
3.10.1.2 Family Melithaeidae	60
3.11 Anemones	61
3.11.1 Order Actinaria	61
3.11.1.1 Family Actiniidae	61
3.11.1.2 Family Aliciidae	61
3.11.1.3 Family Nemanthidae.....	62
3.11.1.4 Family Stichodactylidae	62
3.11.2 Unidentified Anemones.....	63
3.12 Zoanthids	64
3.12.1 Order Zoantharia.....	64
3.12.1.1 Family Sphenopidae	64
3.12.1.2 Family Parazoanthidae	65
3.13 Scleractinian Corals.....	65
3.13.1 Order Scleractinia	65
3.13.1.1 Family Acroporidae.....	65
3.13.1.2 Family Agariciidae.....	66
3.13.1.3 Family Dendrophylliidae	69
3.13.1.4 Family Fungiidae.....	69
3.13.1.5 Family Pocilloporidae.....	70
3.13.1.6 Family Poritidae	72
3.13.1.7 Family Psammocoridae	73
3.13.1.8 Family Scleractinia incertae sedis.....	74
3.14 Black Corals	74
3.14.1 Order Antipatharia	74
3.14.1.1 Family Antipathidae	74
3.14.1.2 Family Myriopathidae	76
3.15 Urchins	76
3.15.1 Order Diadematoidea.....	76
3.15.1.1 Family Diademataidae.....	76
3.15.2 Order Camarodonta	77
3.15.2.1 Family Toxopneustidae	77
3.15.2.2 Family Echinometridae.....	78
3.16 Sea Stars	78
3.16.1 Order Valvatida.....	78
3.16.1.1 Family Acanthasteridae	78
3.16.1.2 Family Asterodiscididae.....	79
3.16.1.3 Family Mithrodiidae.....	80
3.16.1.4 Family Ophidiasteridae.....	80
3.16.1.5 Family Oreasteridae.....	82
3.17 Sea Cucumbers	82
3.17.1 Order Aspidochirotida.....	82
3.17.1.1 Family Holothuriidae.....	82
3.18 Mollusk Shells	83
3.18.1 Order Littorinimorpha.....	83
3.18.1.1 Family Cypraeidae.....	83
3.18.1.2 Family Ranellidae.....	83
3.19 Tunicates.....	84
3.19.1 Order Aplousobranchia.....	84



3.19.1.1 Family Didemnidae84
3.19.1 *Unidentified Tunicate* 84
Chapter 4: References85



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Executive Summary

Encompassing over 1,500,000 km² of pristine ecosystems, the Papahānaumokuākea Marine National Monument (PMNM) surrounding the Northwestern Hawaiian Islands (NWHI) represents the largest marine conservation area on the globe. With the establishment of the PMNM in 2006, there has been an increased emphasis to characterize the biodiversity of the NWHI. The fauna of this remote region has previously been surveyed both in shallow water (< 30 m) using snorkeling and conventional SCUBA diving, as well as in deep water (> 200 m) through the use of trawling, manned submersibles and remotely operated vehicles. However, as in many regions around the globe, little is known about the biodiversity found between these two depth ranges. This intermediate depth zone hosts mesophotic coral ecosystems (MCEs), which are light-dependent coral reefs found below the depth limits of conventional SCUBA diving (> 30 m), and extend to the deepest portion of the photic zone, which may be over 150 m in locations with high water clarity, such as Hawai‘i. MCEs are notoriously under surveyed worldwide, particularly in remote locations like the NWHI. From 2012-2015, annual research expeditions were launched to characterize the biodiversity at mesophotic depths (50-90 m) within PMNM using mixed-gas technical diving. As part of these efforts, the benthic flora and fauna were surveyed using photoquadrat images taken along belt-transects, in combination with collections of biological specimens. Over 200 macrobenthic species were recorded from mesophotic coral ecosystems in the NWHI, including many new species that are in the process of being described. Known benthic species included cyanobacteria, macroalgae, sponges, bryozoans, cnidarians, echinoderms and tunicates. Benthic species recorded during these surveys are described and illustrated. Many of these species are also found on shallow-water reefs across the Hawaiian Archipelago, and as such this guide complements existing taxonomic guides of Hawaiian coral reef flora and fauna.

Chapter 1

INTRODUCTION



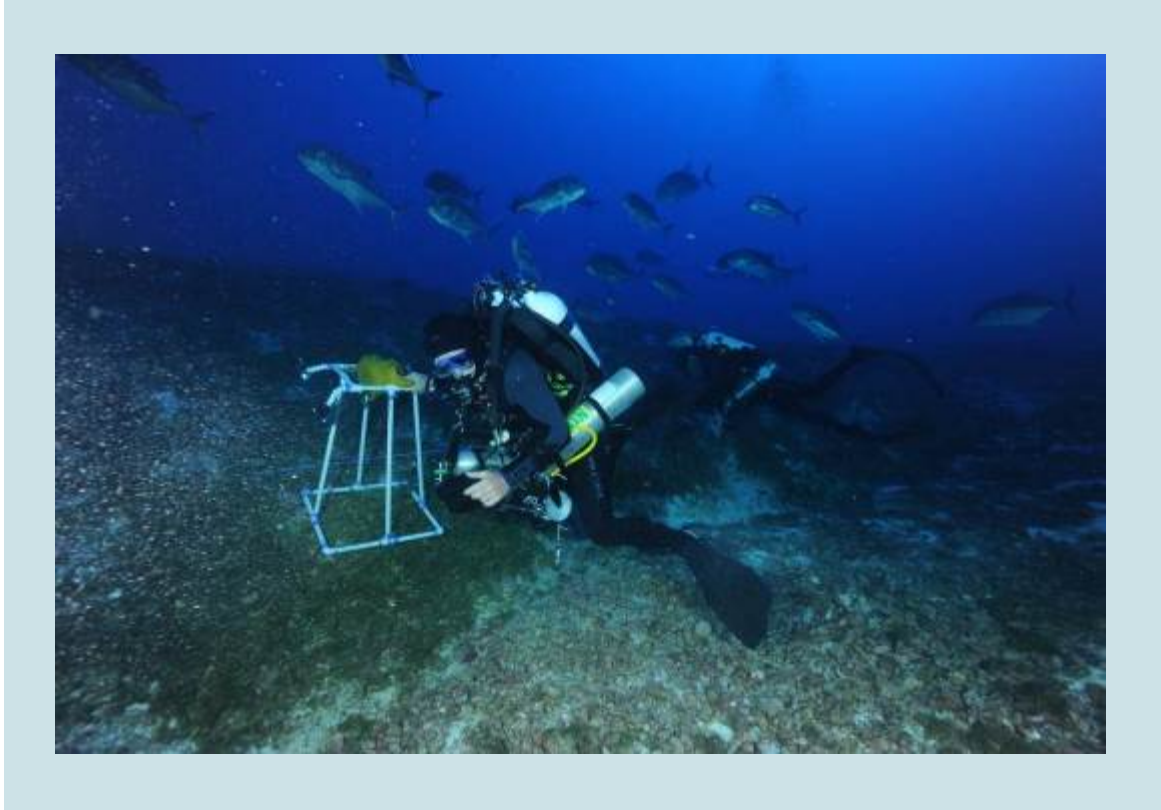
Technical diver surveying a mesophotic coral reef off Pearl and Hermes Atoll in the Papahānaumokuākea Marine National Monument. Photo: Greg McFall/NOAA.

The Papahānaumokuākea Marine National Monument surrounding the Northwestern Hawaiian Islands (NWHI) represents the largest marine protected areas in the world, and is the only world heritage site in the United States that is distinguished for both its cultural and natural resources. With the creation of the Monument in 2006, there has been an increased emphasis on characterizing the resources of the NWHI, including its unique marine biodiversity. The subtidal flora (10–100 m) in the NWHI has mostly been described from drift collections haphazardly caught on lobster traps (reviewed by McDermid and Abbott 2006); these collections have suggested a diverse mesophotic

flora with unique geographic patterns, but *in situ* collections are needed to verify depth distributions and document the attached macroalgae. The benthic fauna of this remote region has previously been surveyed both in shallow water (< 30 m) using conventional SCUBA, as well as in deep water (> 100 m) through the use of trawling, remotely operated vehicles and manned submersibles (reviewed by Wiener & Wagner 2013). However, as in many regions around the world, little is known about the benthic fauna found between these two depth ranges (Rooney et al. 2010; Wagner et al. 2011). This intermediate depth range hosts mesophotic coral ecosystems (MCEs), which are light-dependent coral reefs found below conventional SCUBA diving (> 30 m), and extending to the deepest portion of the euphotic zone, which may be up to 150 m in locations with high water clarity like Hawai‘i (Kahng et al. 2010). MCEs have recently been prioritized for scientific studies around the world, due to a growing realization that their biodiversity is diverse and unique, as well as vastly under surveyed. For instance, the International Union for Conservation of Nature (IUCN) has identified MCEs as a top conservation priority due to their high levels of reef fish biodiversity (Sadovy 2007; Kane et al. 2014; Kosaki et al. 2016), and their importance as refugia for the globally degraded shallow-water reefs (Bongaerts et al. 2010; Kahng et al. 2010). In recent years, dedicated efforts have been launched to systematically survey MCEs within PMNM using mixed-gas technical diving (reviewed by Wiener and Wagner 2013). As part of these efforts, the benthic flora and fauna of PMNM has been surveyed using photoquadrat images taken along belt-transects, in combination with collections of specimens that were identified by taxonomic experts. The purpose of this report is to provide a photographic guide to the benthic flora and fauna at MCEs in the PMNM, in hopes of facilitating future research on these important, yet vastly under surveyed ecosystems. Many of the species described here are also found in shallow-water (<30 m) reefs of the Hawaiian Archipelago, and thus this guide complements existing taxonomic guides of Hawaiian coral reef organisms. Most of the habitats surveyed as part of this study were hard-bottom ledges or slopes dominated by macroalgae, with limited abundances of corals and sponges. As such the inventory of mesophotic species from the NWHI presented herein is most complete for macroalgae, corals and sponges. Benthic species that are typically not found on such habitats in Hawai‘i, such as echinoderms, tunicates and mollusks, are not well inventoried in this guide.

Chapter 2

Materials and Methods



Technical divers conducting a benthic transect using a standard photoquadrat off Pearl and Hermes in the Papahānaumokuākea Marine National Monument. Photo: Greg McFall/NOAA.

All dive surveys were performed using mixed-gas technical diving during annual research expeditions to the NWHI aboard the NOAA Ship *Hi'ialakai* in 2012-2015 (HI-12-05, HI-13-01, HI-14-05 and HI-15-06). These expeditions also included limited dive surveys around Johnston Atoll and the Main Hawaiian Islands, but these were excluded from this report. Dive sites were chosen using historical charts, existing multibeam data archived by the Pacific Islands Benthic Habitat Mapping Center (http://www.soest.hawaii.edu/pibhmc/pibhmc_nwhi.htm), as well as new multibeam data collected by the NOAA Ship *Hi'ialakai*. Chosen dive sites contained steep vertical drop-offs and hard substrate at depths between 50 and 90 m. A total of 157 dive sites were

surveyed in the NWHI including 11 at Nihoa Island, 8 at Mokumanamana Island, 31 at French Frigate Shoals, 2 at Gardner Pinnacles, 3 at Maro Reef, 10 at Laysan Island, 7 off Pioneer Bank, 10 off Lisianski Island, 39 off Pearl and Hermes Atoll, 2 at Salmon Bank, 20 at Midway Atoll and 14 at Kure Atoll (Figure 1). During each survey, divers took photographs every meter along a 25 m transect (Wagner et al. 2014). Upon transect completion, divers collected macroalgae, sponges, corals and other invertebrates that could not be identified *in situ* as time permitted. No crustose coralline algae or turf algae were collected due to time constraints. Collected samples were photographed *in situ*, placed into separate bags and preserved for later identification by taxonomic experts. Additionally, divers recorded the presence of macrobenthic species that were not captured during the transect itself, and documented observations with specimen vouchers. Collected specimens and photographs were identified to the lowest taxonomic level by taxonomic experts. Macroalgal species were identified by Heather Spalding at the University of Hawaii at Mānoa, scleractinian corals by Stephen Cairns at the U.S. National Museum of Natural History, octocorals by Les Watling at the University of Hawaii at Mānoa, antipatharian corals by Daniel Wagner at the Papahānaumokuākea Marine National Monument, sponges by Barbara Calcinaï at the Polytechnic University of Marche, asteroids by Christopher Mah at the U.S. National Museum of Natural History, and other invertebrates by Scott Godwin at the Papahānaumokuākea Marine National Monument. All species names, taxonomic authorities, and family names were checked against the World Register of Marine Species (www.marinespecies.org). Brief species descriptions were generated by reviewing taxonomic guidebooks of Hawaiian coral reef organisms (Abbott 1999; Hoover 2002; Abbott & Huisman 2004; Fenner 2005; Huisman et al. 2007) and summarizing notable morphological characteristics.

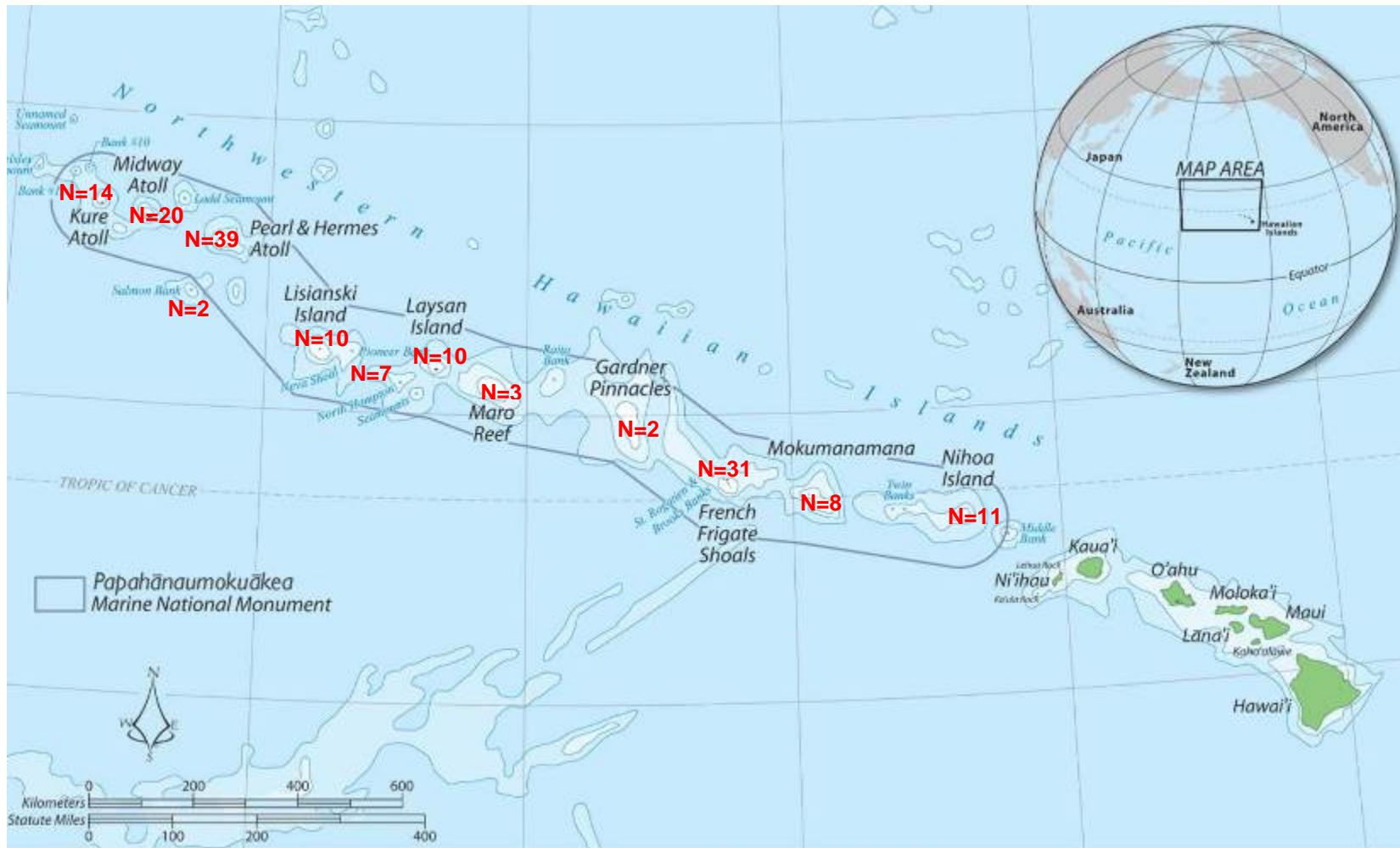


Figure 1. Map showing the location where a total of 157 sites were surveyed at mesophotic depths (50-90 m).

Chapter 3

RESULTS AND DISCUSSION



A mesophotic coral reef at a depth of 70 m off Pearl and Hermes Atoll in the Papahānaumokuākea Marine National Monument. Photo: Greg McFall/NOAA.

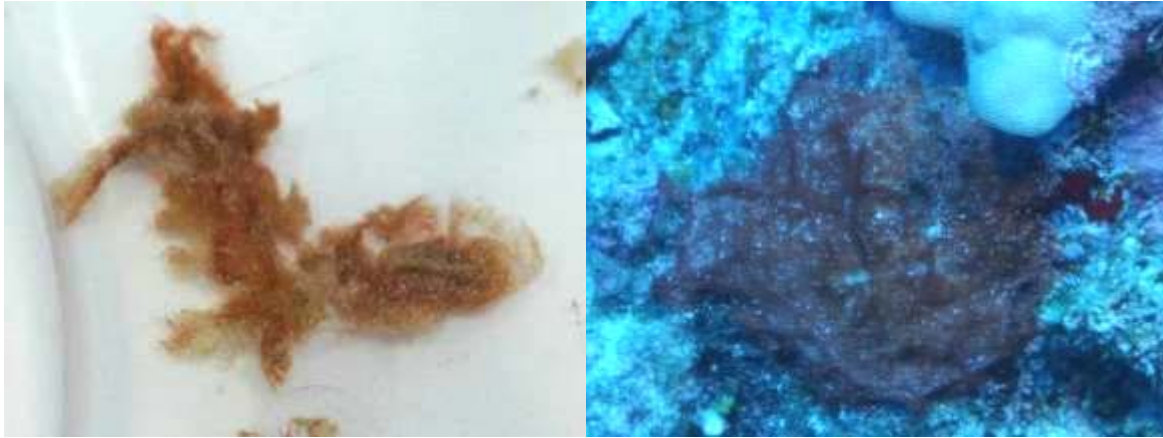
Based on the examination of photoquadrat images and collected specimens, over 200 macrobenthic species were recorded from the Northwestern Hawaiian Islands, including cyanobacteria, macroalgae, sponges, bryozoans, cnidarians, echinoderms and tunicates. All recorded benthic species are described and illustrated. The diagnostic characters of each of these species are highlighted in the figures and descriptions.

3.1 Cyanobacteria

3.1.1 Order Oscillatoriales

3.1.1.1 Family Oscillatoriaceae

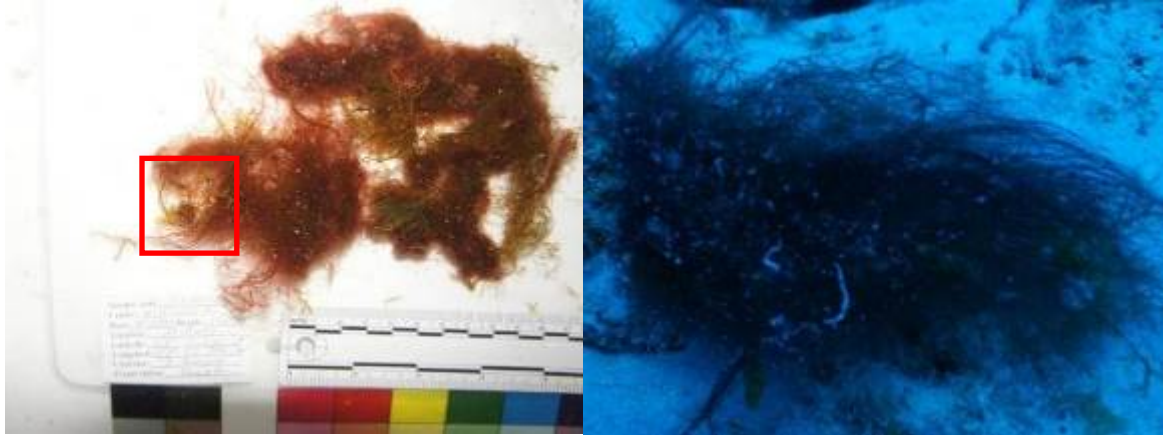
Blennothrix lyngbyacea (Kützing ex Gomont) Anagnostidis & Komárek, 1988



Blennothrix lyngbyacea specimen photographed in the laboratory (left) and *in situ* (right).

This cyanobacterial species forms filamentous mats that appear red or orange *in situ*. The mats are often found entangled in macroalgae, corals or other cyanobacteria.

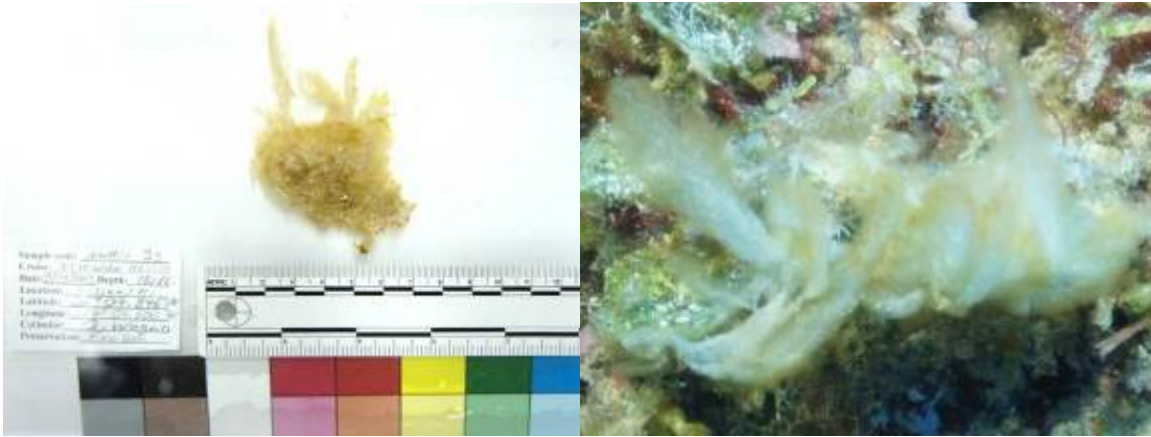
Lyngbya majuscula Harvey ex Gomont, 1892



Lyngbya majuscula specimen photographed in the laboratory (left) and *in situ* (right).

Lyngbya majuscula forms long, unbranched filaments inside a mucilage sheath, with sheets forming tangles or mats. These mats are often entangled in macroalgae, other cyanobacteria or corals.

Phormidium cf. dimorphum Lemmermann, 1908



Phormidium cf. dimorphum specimen photographed in the laboratory (left) and *in situ* (right).

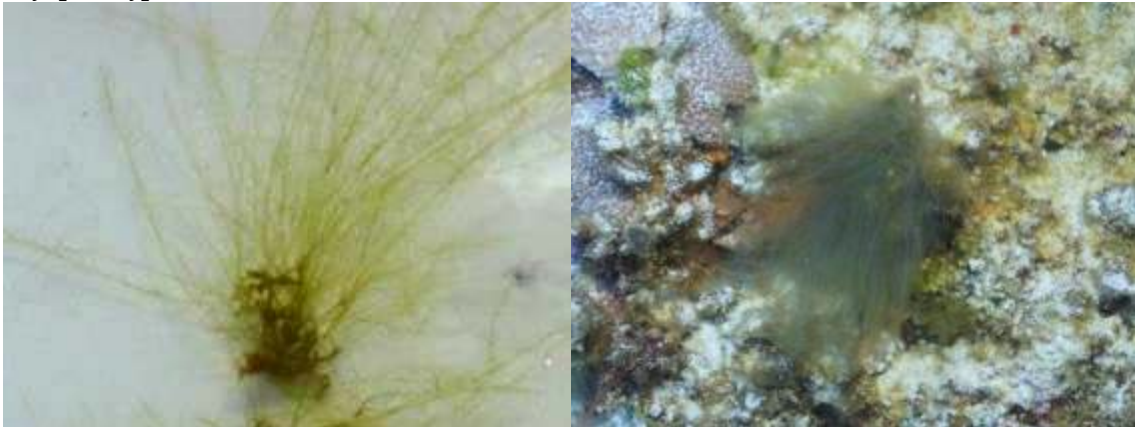
Phormidium cf. dimorphum forms greenish-brown mats that are loosely attached to the benthos. They are frequently observed on macroalgal beds of the genus *Microdictyon* or attached to the substrate.

3.2 Green Macroalgae

3.2.1 Order Bryopsidales

3.2.1.1 Family Bryopsidaceae

Bryopsis hypnoides J.V. Lamouroux, 1809

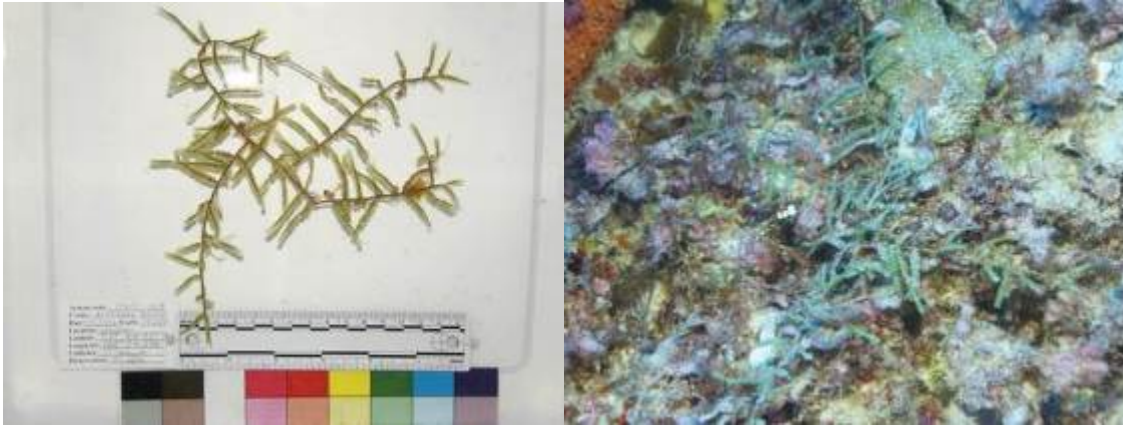


Bryopsis hypnoides specimen photographed in the laboratory (left) and *in situ* (right).

Bryopsis hypnoides is a siphonous macroalga with numerous branched lateral branches. The plant looks like a green cluster of feathers. It grows on hard substrata or as an epiphyte on other macroalgae. Plants are about ~10 cm in height.

3.2.1.2 Family Caulerpaceae

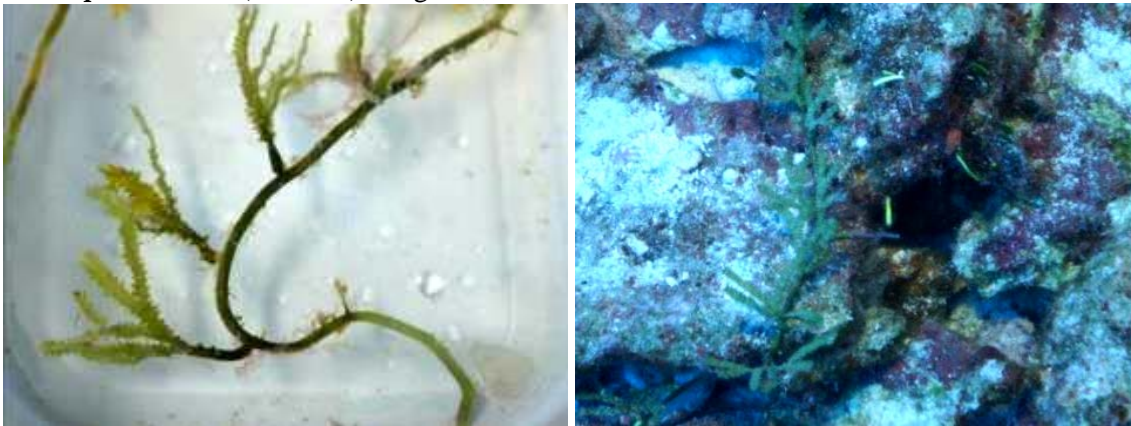
Caulerpa mexicana Sonder ex Kützing, 1849



Caulerpa mexicana specimen photographed in the laboratory (left) and *in situ* (right).

Caulerpa mexicana is bright green in color, but plants are often covered by a thin layer of sediment which obscures its natural coloration. The fronds are spaced out over the vertical branches and have a feather-like appearance. Plants are attached to the substrate or sandy bottoms via root-like structures called stolons.

Caulerpa serrulata (Forsskål) J. Agardh, 1837



Caulerpa serrulata specimen photographed in the laboratory (left) and *in situ* (right).

Caulerpa serrulata grows on rock or coarse sand. The upright fronds have a jagged, or saw-toothed, appearance and can reach vertical heights of ~10 cm, but plants can grow horizontally over much larger areas.

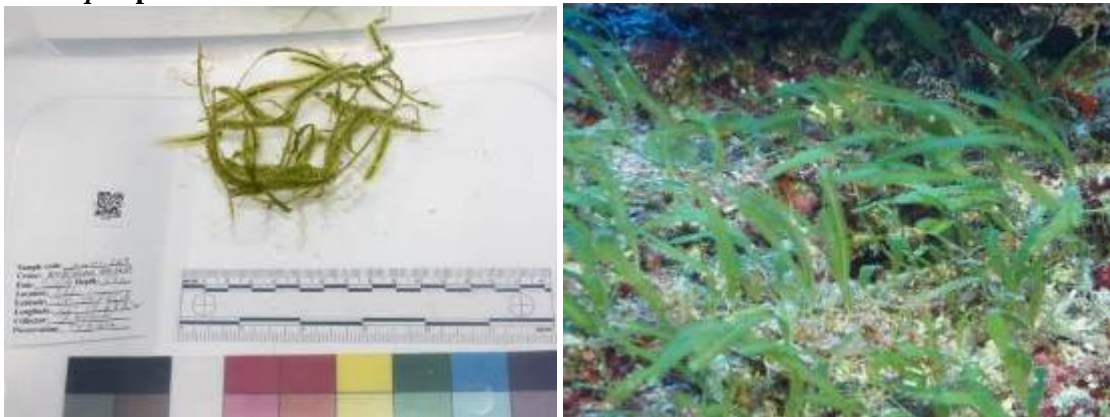
Caulerpa taxifolia (M.Vahl) C.Agardh, 1817



Caulerpa taxifolia specimen photographed in the laboratory (left) and *in situ* (right).

Caulerpa taxifolia generally grows on rocks or sandy substrates. It spreads laterally and has vertical branches with distinctive opposite branchlets that are slightly sickle-shaped with pointed tips. The upright fronds can reach vertical heights of ~13 cm, but plants can grow horizontally over much larger areas.

***Caulerpa* sp.**

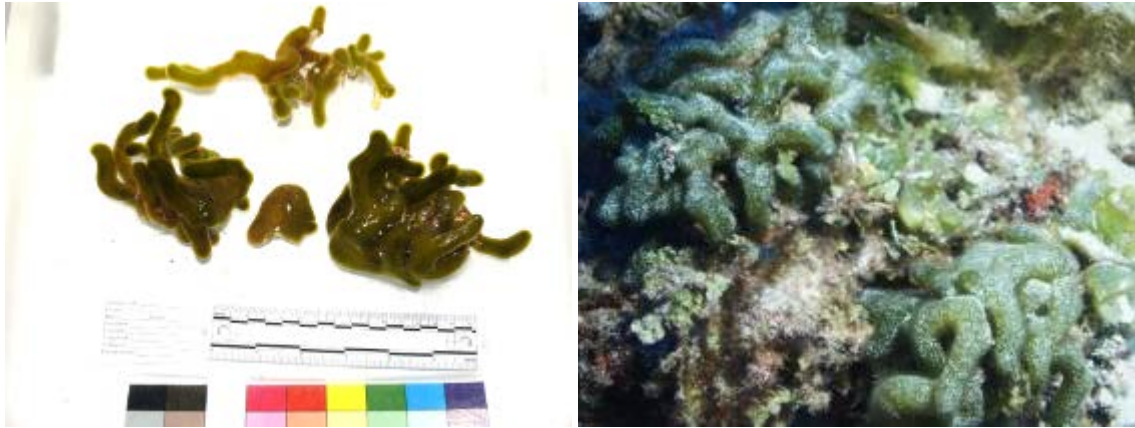


Caulerpa sp. specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified *Caulerpa* species grows in thin blades that look like grass from a distance. Up close, the blades are feather-like with numerous, pinnate branchlets.

3.2.1.3 Family Codiaceae

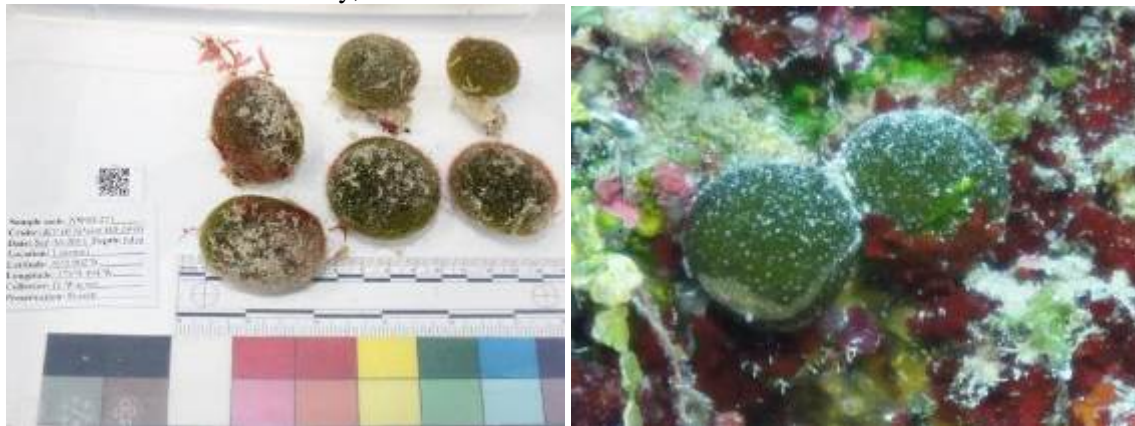
Codium intermedium P.C. Silva & M.E. Chacana, 2013



Codium intermedium specimen photographed in the laboratory (left) and *in situ* (right).

Codium intermedium has the thickest branches among species in this genus. It is dark green and grows in clusters of branches. In the field, plants are often covered with a thin layer of sediment. When void of sediment, *C. intermedium* is dark green in coloration and has a velvety appearance. Plants are loosely attached to the substrate.

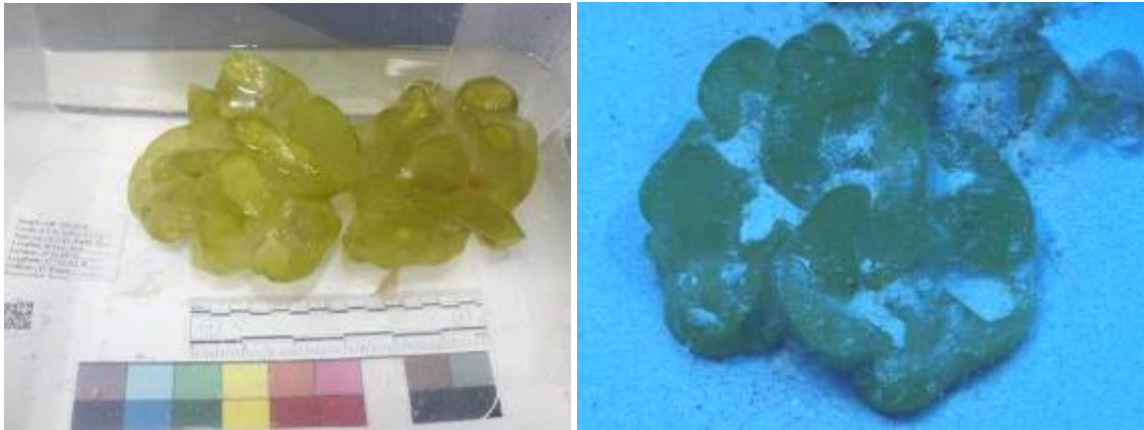
Codium mamillosum Harvey, 1855



Codium mamillosum specimen photographed in the laboratory (left) and *in situ* (right).

Codium mamillosum plants are spherical and attached to the substrate via root-like structures called rhizoids. Plants often have red epiphytes or a thin layer of sediment over them, making them look like circular mounds which typically occur in multiples of two or more.

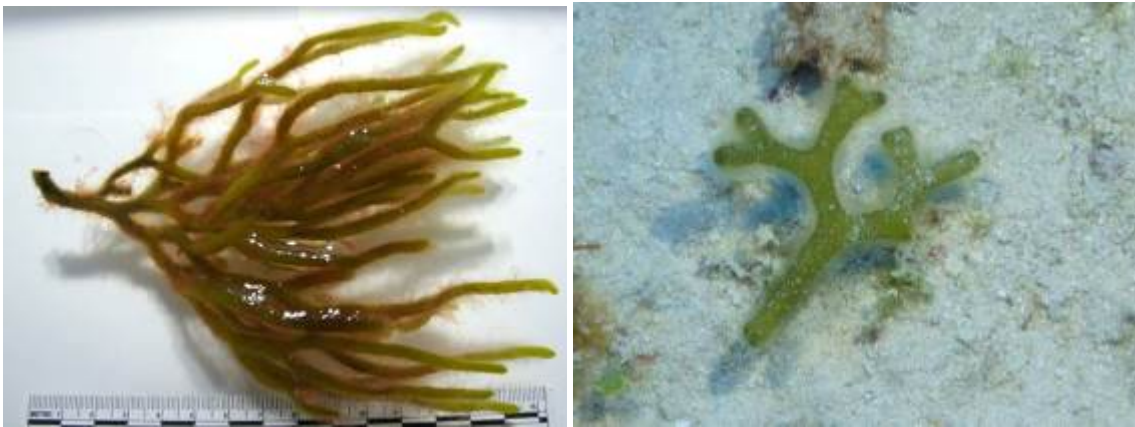
Codium saccatum Okamura, 1915



Codium saccatum specimen photographed in the laboratory (left) and *in situ* (right).

Codium saccatum grows as hollow, sac-like plants that have multiple grooves. It is found on sandy substrates and plants are often covered with a layer of sediment.

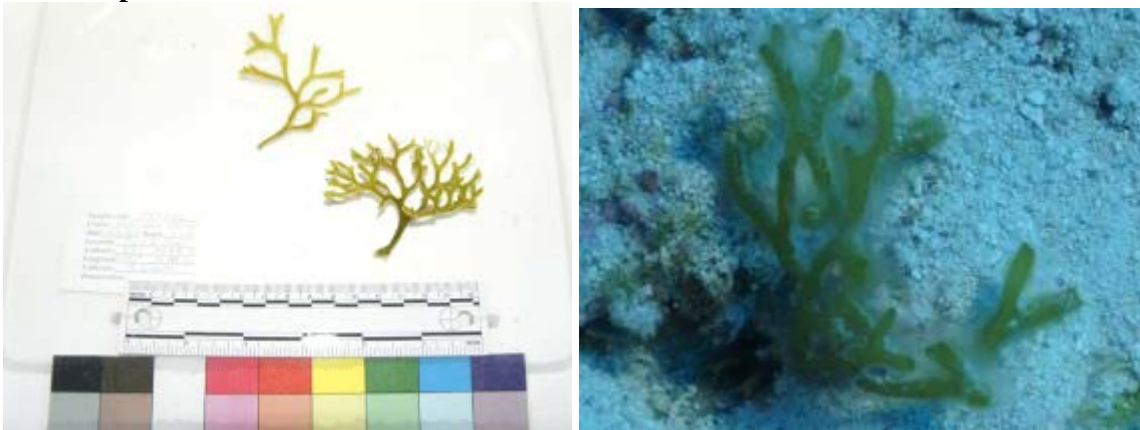
Codium subtubulosum Okamura, 1902



Codium subtubulosum specimen photographed in the laboratory (left) and *in situ* (right).

Codium subtubulosum grows as erect plants that are dichotomously branched. It is green *in situ*, but is frequently overgrown with red epiphytes, which give it a greenish-orange coloration.

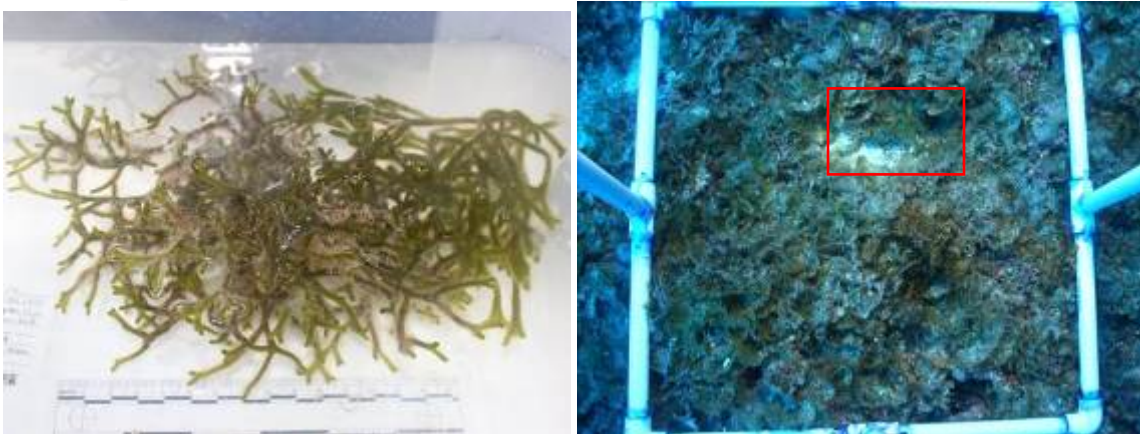
***Codium* sp. 1**



Codium sp. 4 specimen photographed in the laboratory (left) and *in situ* (right).

This undescribed *Codium* species forms small, erect plants that are attached to the substrate via a holdfast and branch dichotomously.

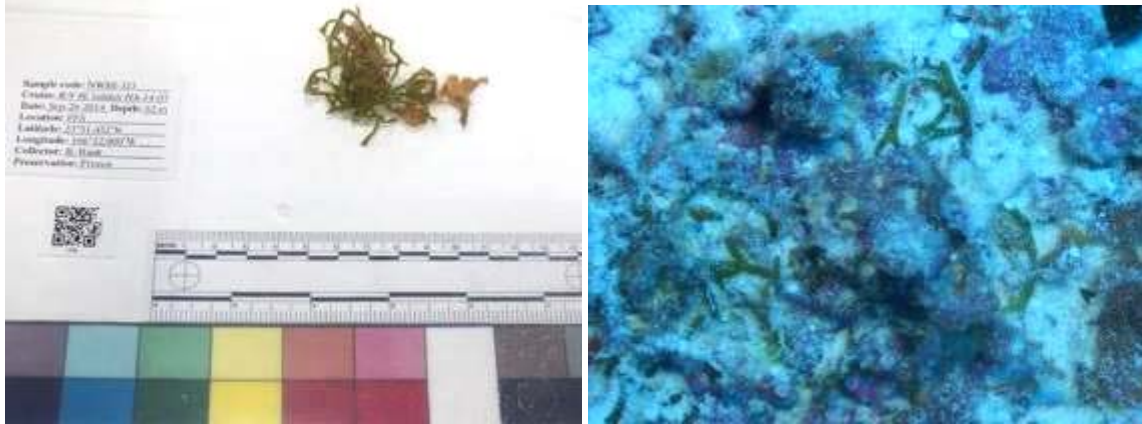
***Codium* sp. 2**



Undescribed *Codium* sp. specimen photographed in the laboratory (left) and *in situ* (right)

The branches of this undescribed species are longer and thinner than other species in the genus *Codium*. Plants grow in small bushes that can extend horizontally over large spaces. It is often found amongst dense *Microdictyon* beds.

***Codium* sp. 3**

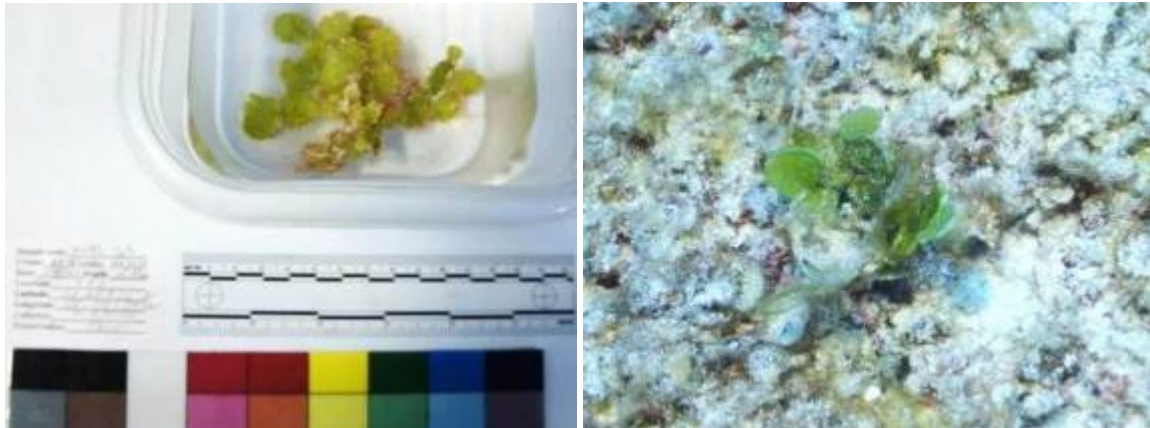


Codium sp. specimen photographed in the laboratory (left) and *in situ* (right).

This undescribed *Codium* species forms erect plants that branch dichotomously. However, branching is less dense than in other species of this genus.

3.2.1.4 Family Halimedaceae

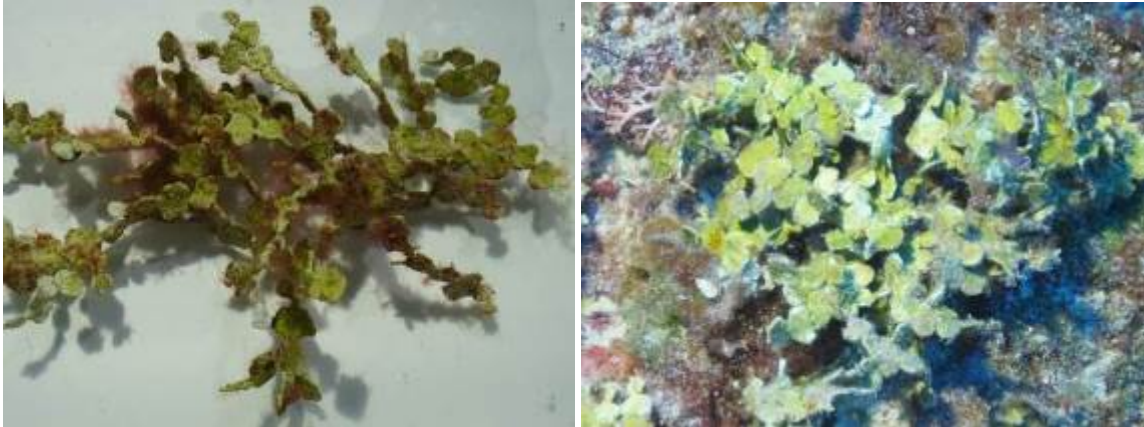
***Halimeda discoidea* Decaisne, 1842**



Halimeda discoidea specimen photographed in the laboratory (left) and *in situ* (right).

Halimeda discoidea forms upright plants with a small holdfast and broad, flattened segments. The segments on the lower part of plants are typically moderately calcified, while segments towards the distal end of branches are smooth. Plants are typically small and reach vertical heights of up to 10 cm. *H. discoidea* is the most common *Halimeda* species in Hawaiian waters.

Halimeda distorta (Yamada) Hillis-Colinvaux, 1968



Halimeda distorta specimen photographed in the laboratory (left) and *in situ* (right)

Halimeda distorta is characterized by broad, contorted segments that are about 1 cm in diameter, ovular in shape and heavily calcified. Plants are often covered by a thin layer of sediment or epiphytes.

Halimeda taenicola W.R. Taylor, 1950



Halimeda taenicola specimen photographed in the laboratory (left) and *in situ* (right).

Halimeda taenicola is characterized by broad, thick and flattened segments that are about 1 cm in diameter and ovular in shape. The segments are either moderately calcified or smooth.

Halimeda velasquezii W.R. Taylor, 1962

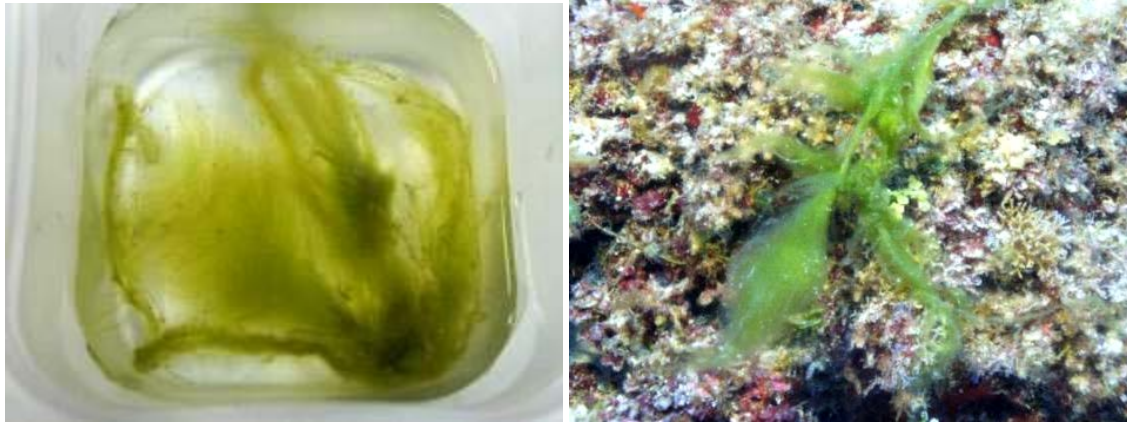


Halimeda velasquezii specimen photographed in the laboratory (left) and *in situ* (right).

Halimeda velasquezii is characterized by broad, flattened, ovular segments that are 4-11 mm wide. Plants are attached to the substrate via a holdfast and grow erect reaching vertical heights of about 7 cm.

3.2.1.5 Family Udoteaceae

Siphonogramen parva (W. J. Gilbert) I. A. Abbott and Huisman, 2004



Siphonogramen parva specimen photographed in the laboratory (left) and *in situ* (right).

Siphonogramen parva forms uncalcified filaments that are bright green *in situ*. Plants are mostly branched near the base, with upper filaments generally not branching. This alga can often be found entangled in sand, other macroalgae, or cyanobacteria.

3.2.2 Order Cladophorales

3.2.2.1 Family Anadyomenaceae

Microdictyon setchellianum H.A. Howe, 1934



Microdictyon setchellianum specimen photographed in the laboratory (left) and *in situ* (right).

Microdictyon setchellianum forms flattened green blades that are composed of a meshwork of branches. Up close the blades have a net-like appearance. When present, this species is typically the dominant macrobenthic species covering the benthos in the Northwestern Hawaiian Islands. Plants are often covered with sand, crustose coralline algae or other epiphytes.

3.2.2.2 Family Cladophoraceae

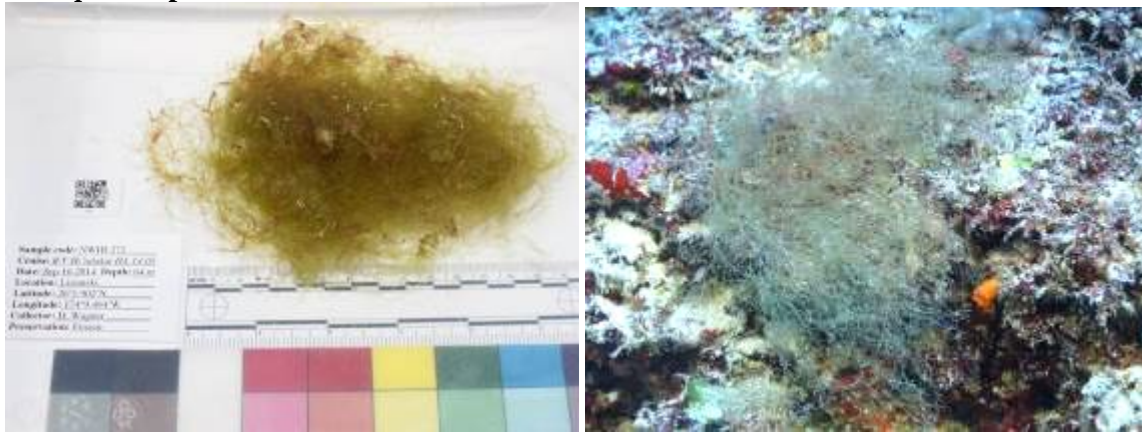
Cladophora sp. 1



Cladophora sp. specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified species of *Cladophora* grows in small, uniseriate filaments that form wispy plants. It is greenish-brown *in situ* and attached to hard substrates.

***Cladophora* sp. 2**



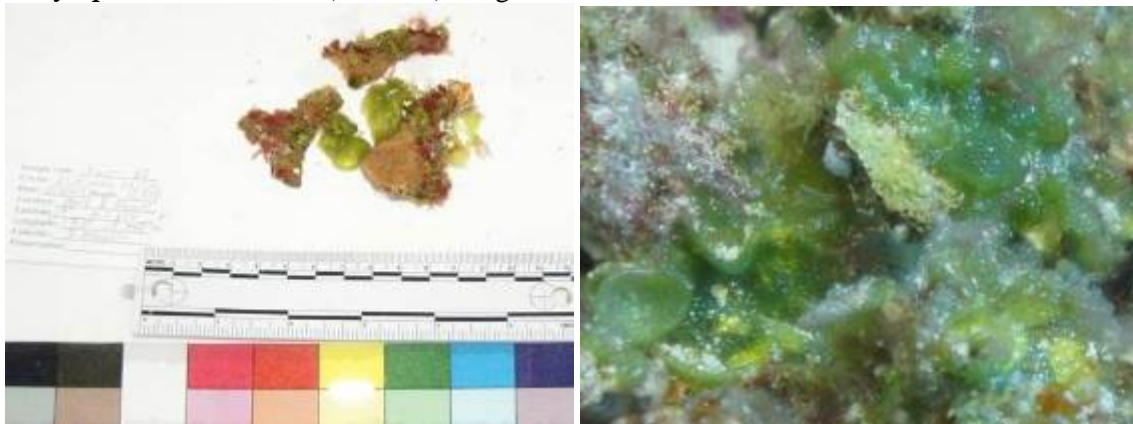
Cladophora sp. specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified *Cladophora* species forms bushy plants with long filaments that are loosely attached to the substrate. Plants are greenish-brown *in situ*.

3.2.3 Order Siphonocladales

3.2.3.1 Family Siphonocladaceae

***Dictyosphaeria cavernosa* (Forsskål) Børgesen, 1932**



Dictyosphaeria cavernosa specimen photographed in the laboratory (left) and *in situ* (right).

Dictyosphaeria cavernosa plants grow upright, are bright green in coloration, and are hollow. Plants have several segments that attach to one another, with distal segments often opening, thereby becoming cup-shaped. *D. cavernosa* typically grows on rock, inside small cracks or between coral fingers. Plants are up to 12 cm in height.

Siphonocladus tropicus (P.L. Crouan & H.M. Crouan) J. Agardh, 1887



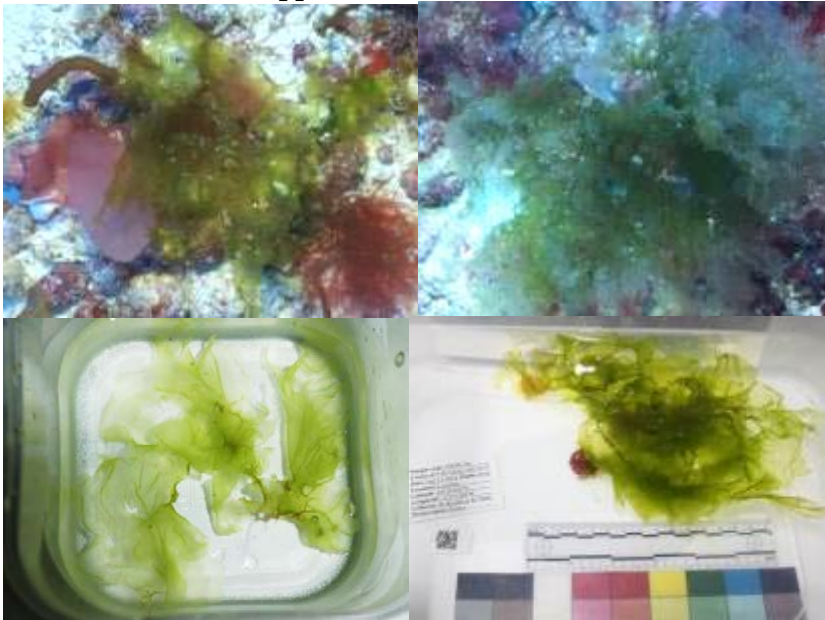
Siphonocladus tropicus specimen photographed in the laboratory (left) and *in situ* (right).

Siphonocladus tropicus plants appear in loose tufts that are attached to the bottom via root-like structures called rhizoids. Plants are often thicker at their base and divided into numerous branches that are segmented in appearance due to small spheres inside parent filaments. *S. tropicus* grows on rocks and pieces of coral. Plants reach vertical heights of ~5 cm.

3.2.4 Order Ulvales

3.2.4.1 Family Ulvaceae

Ulva and *Umbraulva* spp.



Various *Ulva* and *Umbraulva* specimens photographed in the laboratory (top) and in the field (bottom).

Ulva and *Umbraulva* spp. have green, ruffled, translucent membranes that are attached by a disc-like holdfast to rocks or hard substrate. Both of these genera are very similar morphologically and thus require molecular analyses to differentiate them.

3.3 Red Macroalgae

3.3.1 Order *Acrosymphytales*

3.3.1.1 Family *Acrosymphytaceae*

Acrosymphyton sp.



Unidentified *Acrosymphyton* specimen photographed in the laboratory.

Acrosymphyton sp. forms tubular branches with tiny, tapered, bushy branches coming off the tips. Plants are small, gelatinous and delicate.

3.3.2 Order *Bonnemaisoniales*

3.3.2.1 Family *Bonnemaisoniaceae*

Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon, 1845



Asparagopsis taxiformis specimen photographed in the laboratory (left) and *in situ* (right).

Plants of *Asparagopsis taxiformis* have pinkish or grayish upright axes. The branches are fine and taper towards the ends. It is found on hard substrates or as an epiphyte. Thalli are up to 20 cm in height.

3.3.2.2 Family Naccariaceae

Reticulocaulis mucosissimus I.A. Abbott, 1985



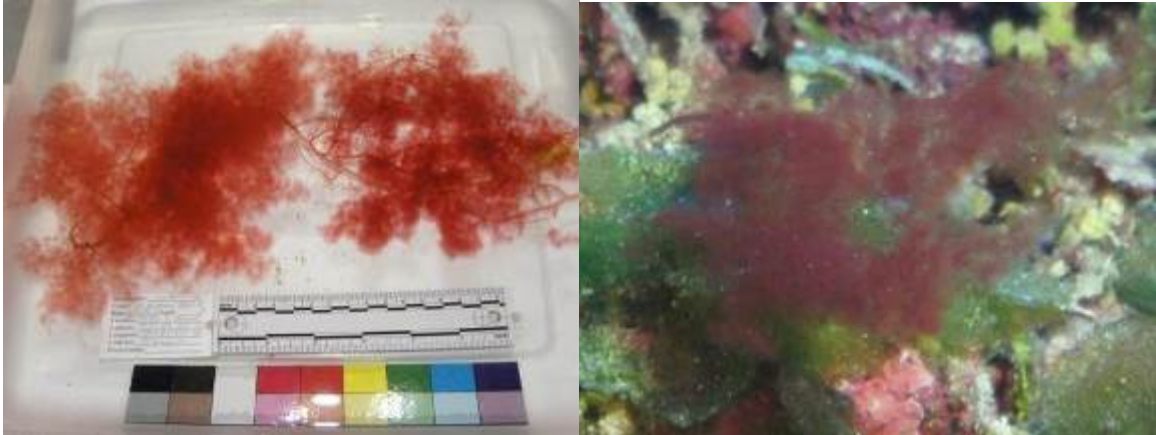
Reticulocaulis mucosissimus specimen photographed in the laboratory (left) and *in situ* (right).

Reticulocaulis mucosissimus plants are attached to the substrate via rhizoidal cells, grow upright and are extremely gelatinous with a hair-like appearance. Plants are red or orange in coloration and grow on hard substrates. Plants reach vertical heights of up to ~15 cm.

3.3.3 Order Ceramiales

3.3.3.1 Family Dasyaceae

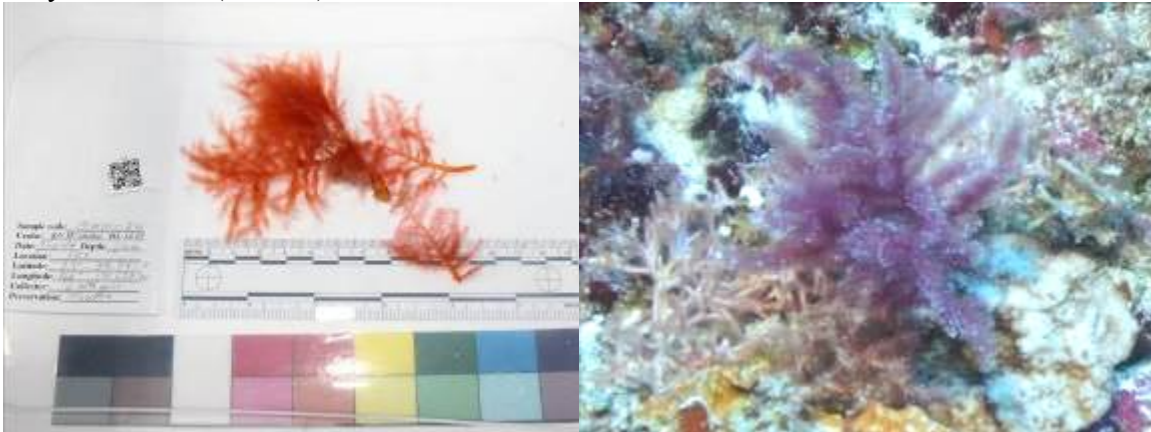
Dasya atropurpurea Vroom, 2005



Dasya atropurpurea specimen photographed in the laboratory (left) and *in situ* (right).

Dasya atropurpurea is distinguishable by its bright red color and fine branching. It is a finely branched species, with branches often breaking off plants and found free floating, entangled on the substrate or on other benthic species. Blooms of this species have been observed at several mesophotic sites in the Northwestern Hawaiian Islands.

Dasya iridescens (Schlech) A.J.K. Millar & I.A. Abbott, 1996



Dasya iridescens specimen photographed in the laboratory (left) and *in situ* (right).

Dasya iridescens is characterized by thin branches that are covered by numerous pigmented filaments, giving the plants a shaggy appearance. Plants are small, reaching vertical heights of up to 7 cm, but often conspicuous due to their blue iridescence.

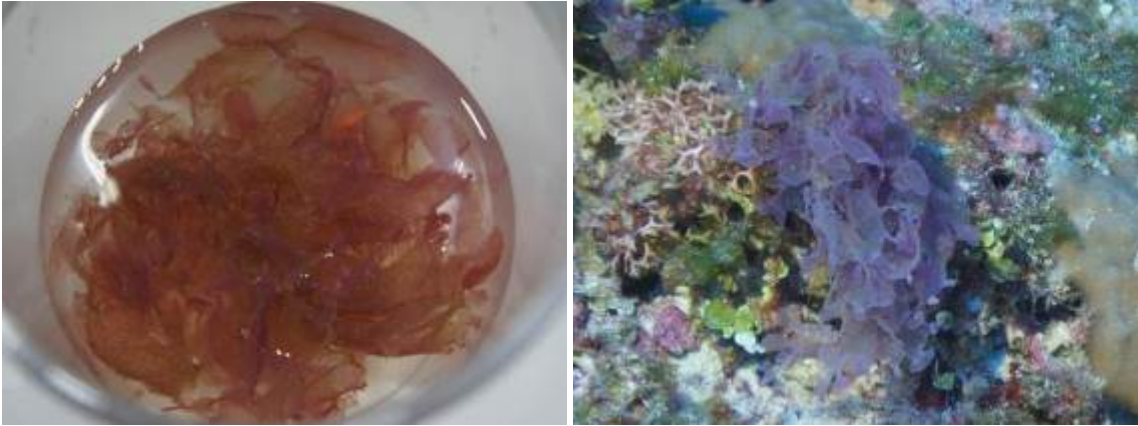
Dasya sp.



Unidentified *Dasya* specimen photographed in the laboratory (left) and *in situ* (right).

Like *Dasya iridescens*, this unidentified *Dasya* sp. is characterized by thin branches that are covered by numerous pigmented filaments, giving the plants a shaggy appearance. However, this unidentified species branches much more densely than *D. iridescens*.

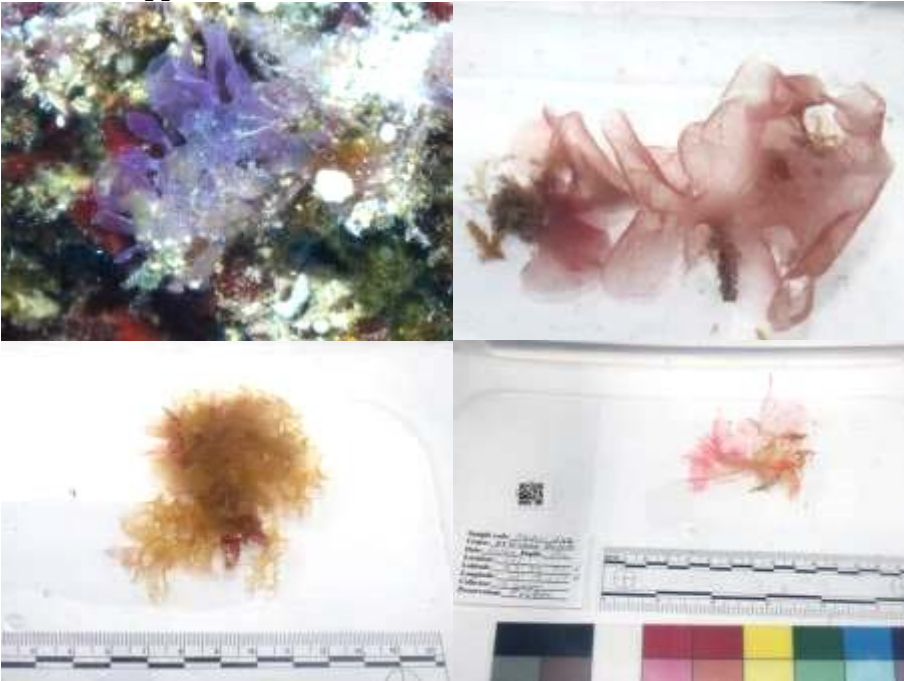
3.3.3.2 Family Delesseriaceae
***Martensia fragilis* Harvey, 1854**



A *Martensia fragilis* specimen photographed in the laboratory (left) and *in situ* (right).

Martensia fragilis plants are purple or pink with a blue iridescence. It is wholly blade-like when young and becomes net-like distally. It can be smooth, toothed, or lobed. Blades are delicate and thin. Plants can reach vertical heights of ~10 cm.

***Martensia* spp.**



Various species in the genus *Martensia* photographed *in situ* and in the lab

Several species *Martensia* are present at mesophotic depths in the Northwestern Hawaiian Islands. Plants are characterized by a folded, membranous appearance and are red, red-brown or iridescent in coloration.

3.3.3.3 Family Rhodomelaceae

Acanthophora pacifica (Setchell) Kraft, 1979



Acanthophora pacifica specimen photographed in the laboratory (left) and *in situ* (right).

Acanthophora pacifica has upright fronds that are flattened, with spine-like branches confined to the apices. It is generally epilithic and has greenish-blue iridescent tips. Plants can reach vertical heights of ~10 cm.

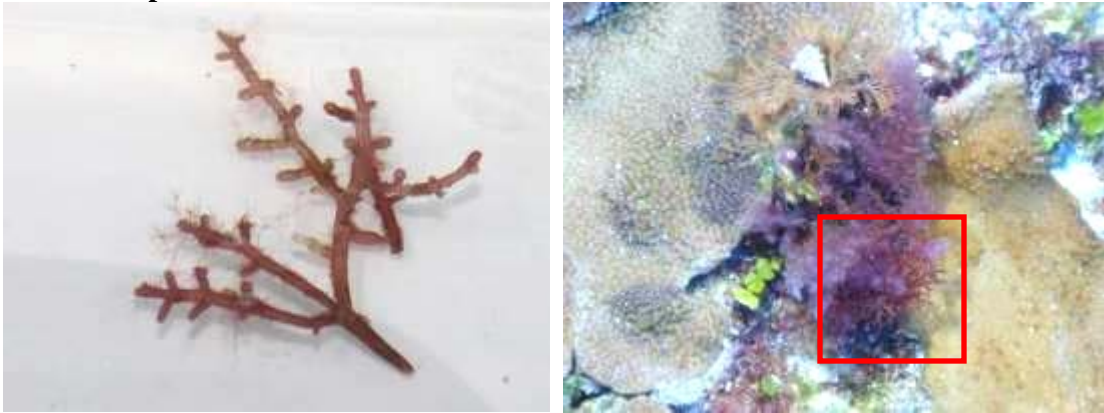
Amansia glomerata C. Agardh, 1822



Amansia glomerata specimens photographed in the laboratory.

Amansia glomerata has distinctive rosettes of flattened branches with short marginal serrations topping stem-like branches. It is rarely solitary, and mostly found as a basiophyte for larger macroalgae or cyanobacterial mats. Plants reach sizes of up to ~6 cm.

***Laurencia* sp.**



Laurencia sp. specimen photographed in the laboratory (left) and *in situ* (right).

Laurencia sp. forms small, erect plants with dichotomous branches. Plants are frequently overgrown with other macroalgae. Like other species in this genus, *Laurencia* sp. has distinctive branch apices with terminal pits.

***Veleroa setteana* I.A. Abbott & D.L. Ballantine 2012**



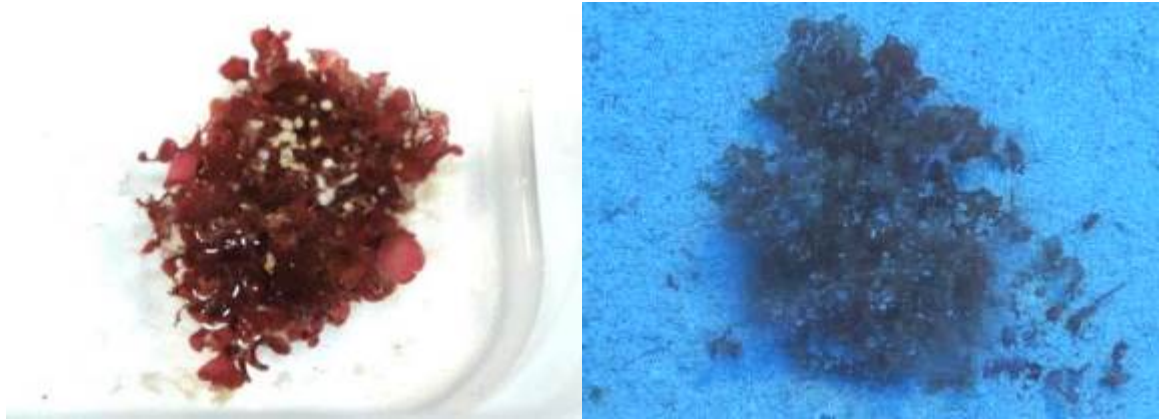
Veleroa setteana specimen photographed in the laboratory (left) and *in situ* (right).

Veleroa setteana appears orange or rust-like red when alive. It forms bushy plants that can reach heights of up to 30 cm and has dense, feather-like branches.

3.3.4 Order Gigartinales

3.3.4.1 Family Chondrymeniaceae

Dissimularia umbraticola (E.Y.Dawson) G.T.Kraft & G.W.Saunders, 2014



Dissimularia umbraticola specimen photographed in the laboratory (left) and in the field (right).

Dissimularia umbraticola plants grow in dense turfs, consisting of rounded lobes that are approximately 2-3 cm in height. Plants are dark red in coloration.

3.3.4.2 Family Dumontiaceae

Dudresnaya sp.



Dudresnaya sp. specimen photographed in the laboratory (left) and *in situ* (right).

Dudresnaya sp. plants are pinkish-red in the field and extremely gelatinous. They have tubular branches with several orders of branching. Plants in this genus are the most common gelatinous algae in the Hawaiian marine flora.

***Gibsmithia hawaiiensis* Doty, 1963**

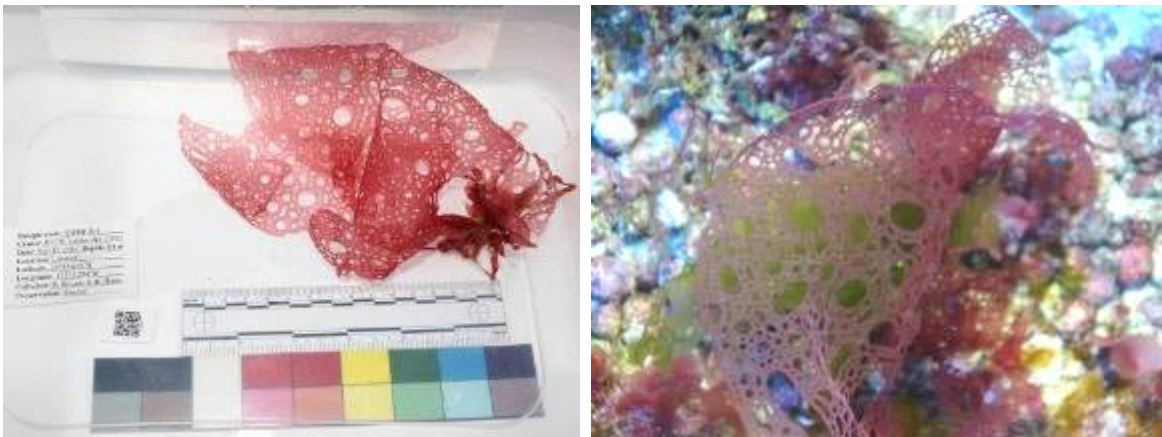


Gibsmithia hawaiiensis specimen photographed in the laboratory (left) and *in situ* (right).

Gibsmithia hawaiiensis has firm, cartilaginous stalks with soft, gelatinous upper branches. Plants are often found in small groups, in cracks or between corals, or on other hard substrates. Plants have a shaggy appearance and are typically smaller than 8 cm in height.

3.3.4.3 Family Kallymeniaceae

***Kallymenia?* sp.**



Kallymenia? Sp. specimen photographed in the laboratory (left) and *in situ* (right).

This species is characterized by a net-like appearance and large circular holes. Plants are bright *in situ*.

3.3.4.4 Family Rhizophyllidaceae

Portieria hornemannii (Lyngbye) P.C.Silva, 1987



Portieria hornemannii specimen photographed in the laboratory (left) and *in situ* (right).

Portieria hornemannii forms planar plants that have a distinctive alternating branching pattern. A distinguishing feature of this species is that it forms curled tips at the end of branches and has a pungent odor. *P. hornemannii* grows on rock and is either bright orange or red in coloration. Plants reach heights of up to ~12 cm.

3.3.5 Order Nemaliales

3.3.5.1 Family Galaxauraceae

Dichotomaria marginata (J.Ellis & Solander) Lamarck, 1816



Dichotomaria marginata specimen photographed in the laboratory (left) and *in situ* (right).

Dichotomaria marginata is a calcified, dichotomously branching red macroalgae. This species has mostly flattened branches and is generally found growing on rocks. Plants can reach vertical heights of up to ~12 cm, but can spread horizontally over larger distances.

3.3.5.2 Family Scinaiaaceae

Scinaia sp.



Unidentified *Scinaia* specimen photographed in the laboratory (left) and *in situ* (right).

Scinaia sp. plants are red and have closely packed narrow branches that branch dichotomously. Plants are firmly attached to hard substrates.

3.3.6 Order Halymeniales

3.3.6.1 Halymeniaceae

Halymenia sp.



Unidentified *Halymenia* specimen photographed in the laboratory.

Halymenia sp. is characterized by elongated blades that end in bifurcated, pointy tips. Plants are firmly attached via a holdfast and are bright red.

3.3.7 Order *Nemastomatales*

3.3.7.1 Family *Nemastomataceae*

Predaea sp.



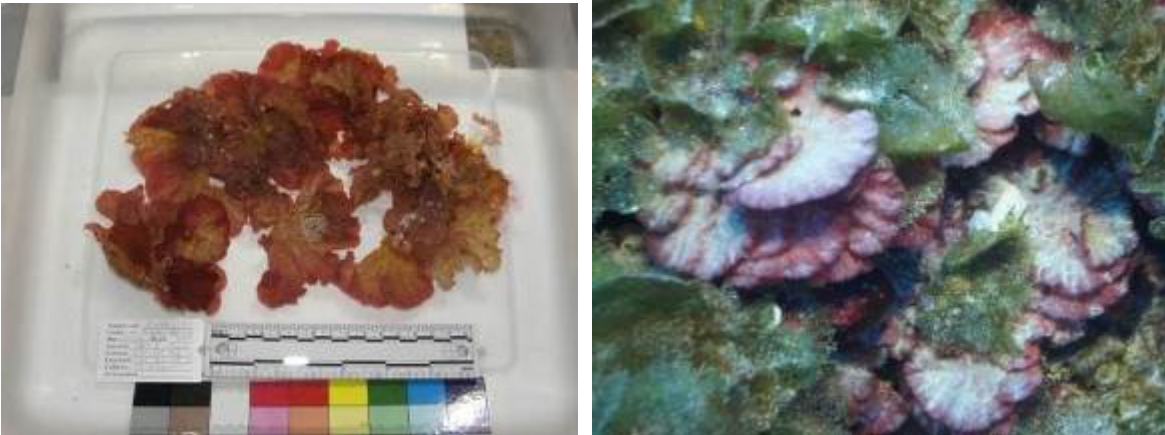
Unidentified *Predaea* sp. specimen photographed in the laboratory (left) and *in situ* (right).

Like other species in this genus, *Predaea* sp. forms gelatinous plants that are attached to hard substrate via a holdfast.

3.3.8 Order *Peyssonneliales*

3.3.8.1 Family *Peyssonneliaceae*

Peyssonnelia sp.



Unidentified *Peyssonnelia* specimen photographed in the laboratory (left) and *in situ* (right).

Peyssonnelia sp. plants form lightly calcified blades with yellow to brown centers and reddish pink edges. Plants are shaped like clusters of flower petals or lettuce leaves. It grows in mats and is often covered with sand or sediment. The blades are slightly calcified.

3.3.9 Order Plocamiales

3.3.9.1 Family Plocamiaceae

Plocamium sandvicense J. Agardh, 1892

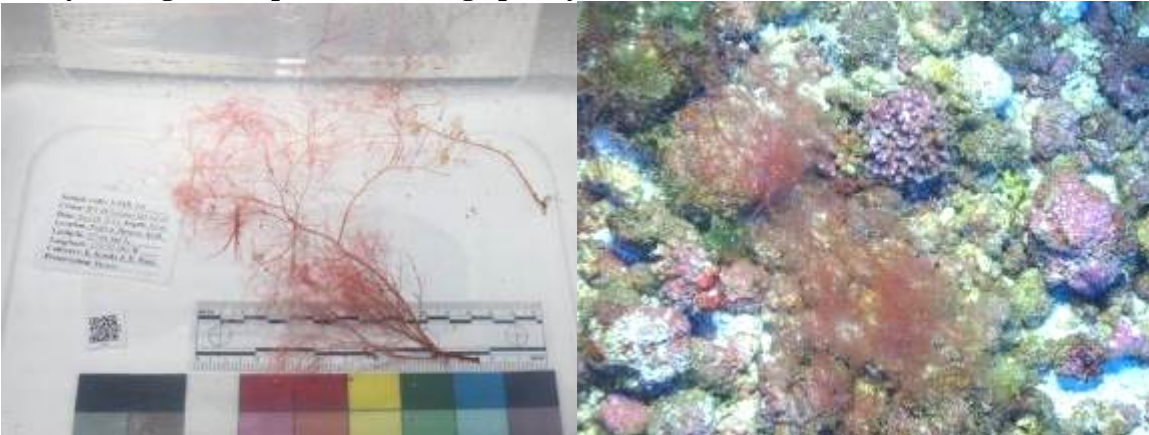


Plocamium sandvicense specimen photographed in the laboratory.

Plocamium sandvicense has flattened axes that branch in a characteristic pattern of alternating pairs of lateral branches, with the lower of each pair short and undivided, and the upper developing into a long branch similar in form to the main axis. Plants are planar and reach vertical heights of ~ 10 cm.

3.3.10 Unidentified Red Macroalgae

Bushy red alga with sparse branching apically



Unidentified red alga specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified red alga firmly attaches to the substrate via a holdfast. Plants are ~25 cm in height and bushy, with sparse branches that become narrower distally.

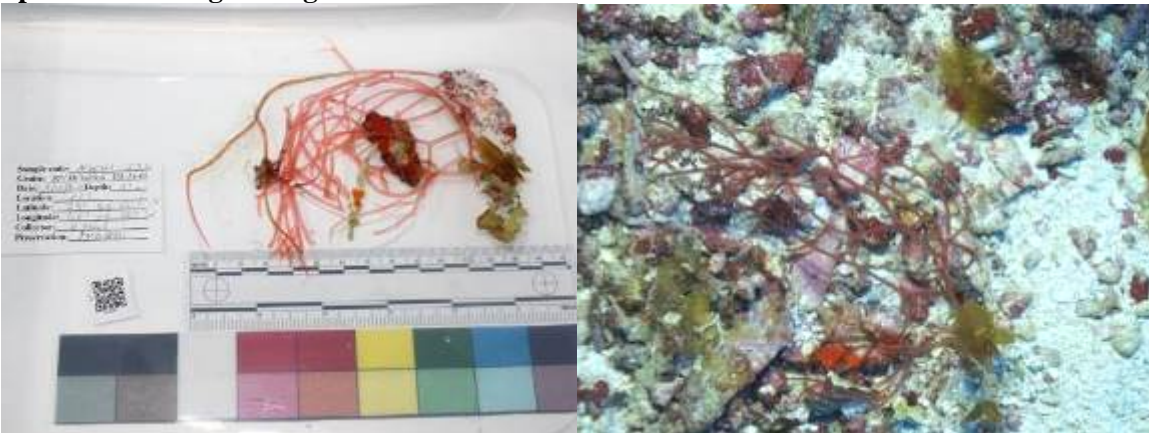
Bushy gelatinous red alga



Unidentified bushy gelatinous red algae photographed *in situ* (top) and in the laboratory (bottom).

This unidentified red alga attaches to the substrate via a holdfast. Plants are ~25 cm in height, bushy and gelatinous, with branches that become narrower distally.

Sparse branching red alga



Unidentified red alga specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified alga branches very sparsely and has small plants that reach heights of ~20 cm.

Small bifurcated branching red alga



Unidentified red alga specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified red alga has very small plants that reach heights of ~15 cm. Plants consist of a single stem that bifurcates distally and are dark red in coloration.

Bifurcated branching red alga with flattened branches



Unidentified bushy gelatinous red algae photographed *in situ* (top) and in the laboratory (bottom).

This unidentified red alga has attached to the substrate via a holdfast. Plants branch dichotomously and branches are flattened. Spores are often visible on the branches.

Rubbery red algae



Various unidentified rubbery red algae photographed in the laboratory.

Several unidentified species of red algae with rubbery texture have been collected from the Northwestern Hawaiian Islands. Plants of these species are typically quite small (~10 cm) and are distinctly rubbery to the touch.

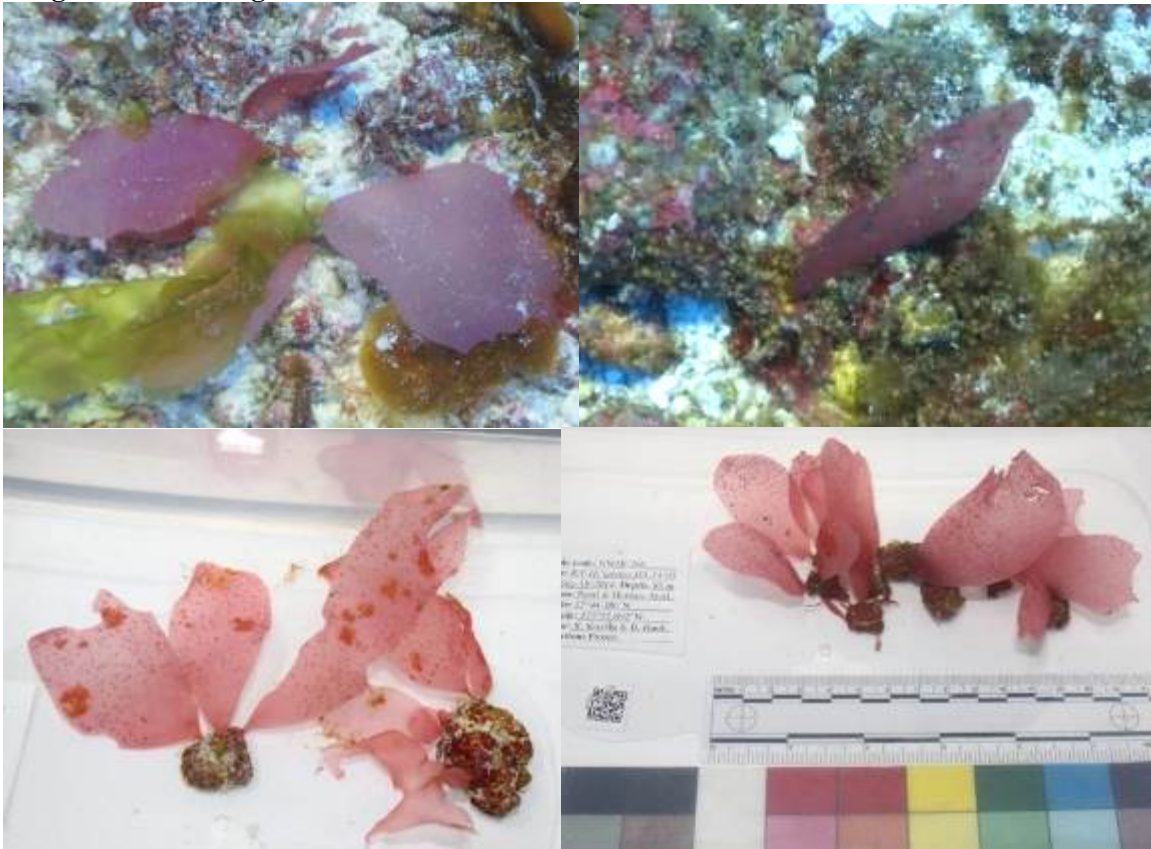
Fern-like red alga



Unidentified red alga specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified red alga is small with rubbery stems and with small blades branching in pairs on the main stem like a fern.

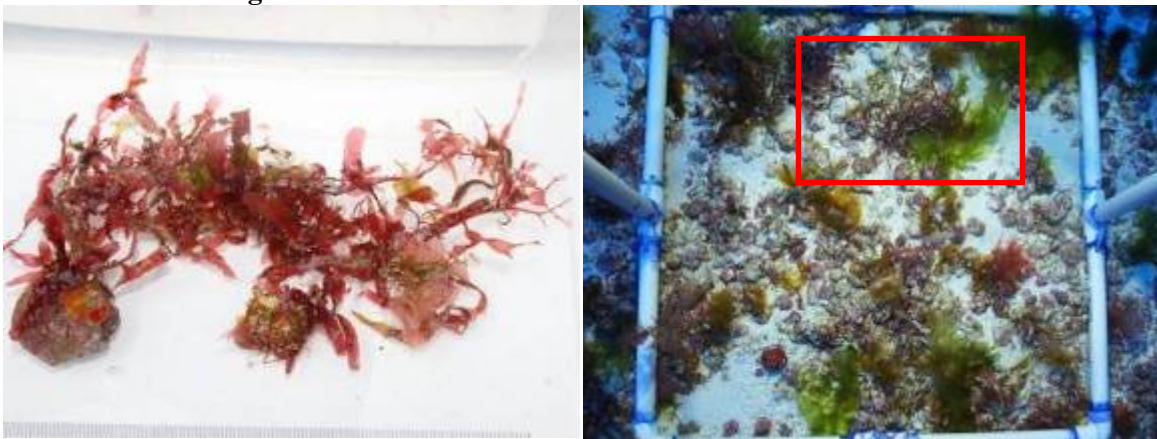
Large bladed red alga



Unidentified red alga specimen photographed *in situ* (top) and in the laboratory (bottom).

This unidentified red alga has large flattened blades that are firmly attached to the substrate via a holdfast. Blades are rubbery to the touch and often times covered with numerous small spores.

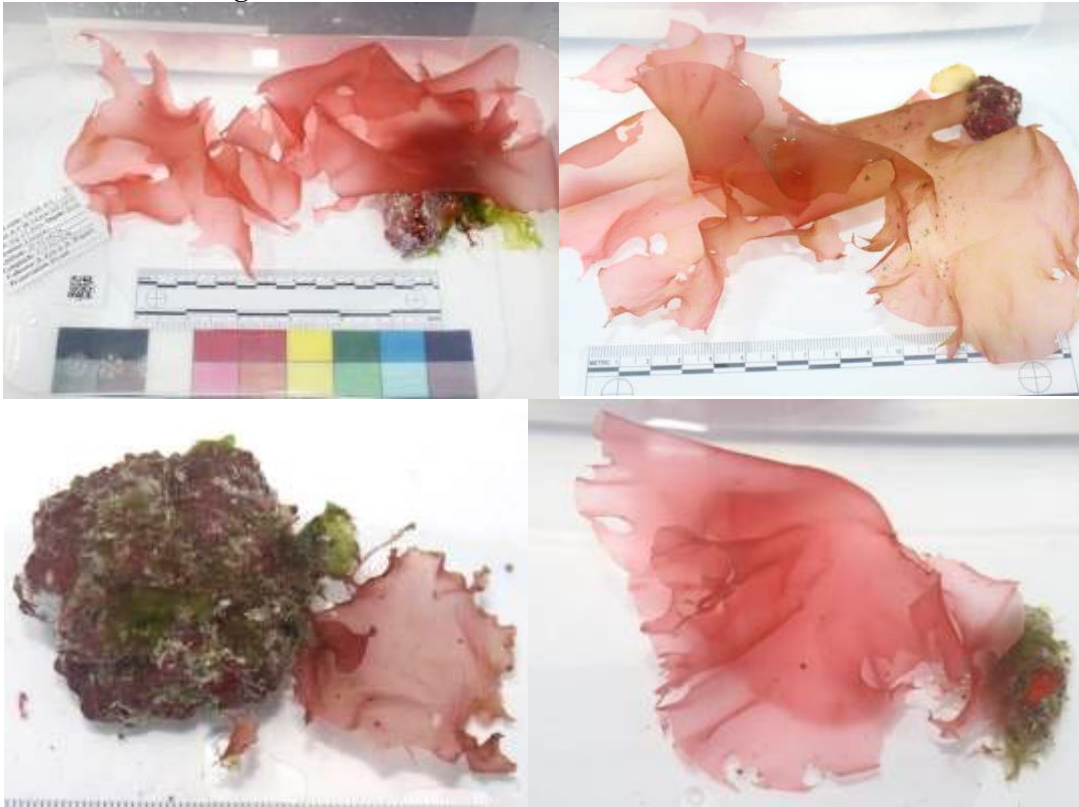
Small bladed red alga



Unidentified red alga specimen photographed in the laboratory (left) and *in situ* (right).

This identified red alga has small blades that are firmly attached to the substrate.

Lettuce-like red alga



Unidentified, lettuce-like red alga specimens photographed in the laboratory.

This unidentified red alga is similar in morphology to the green alga in genus *Ulva*, however, plants are red. Spores often visible on tissues.

Other unidentified red alga



Various species of unidentified red alga specimens photographed in the laboratory.

Several other red algal species that have not yet been identified have been collected in the Northwestern Hawaiian Islands.

3.4 Brown Macroalgae

3.4.1 Order Dictyotales

3.4.1.1 Family Dictyotaceae

Padina melemele I.A. Abbott & Magruder, 1996



Padina melemele specimen photographed in the laboratory (left) and *in situ* (right).

Padina melemele is distinguished by the bright golden color of its non-calcified outer surface of blades. The inner surface of blades is heavily calcified, and is white in coloration. This algal species is typically found attached to the sides of rocks, where light levels are lower.

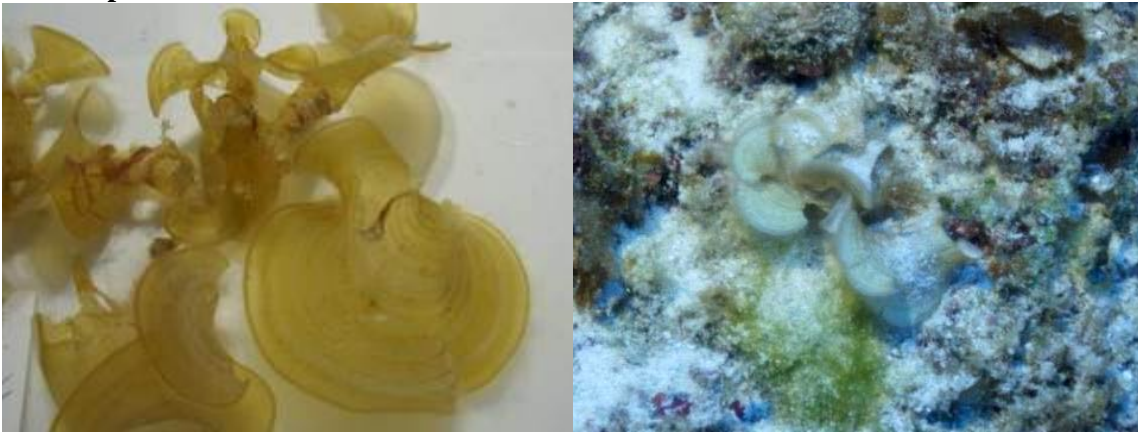
Padina cf. moffittiana Abbott & Huisman 2003



Padina moffittiana specimen photographed in the laboratory (left) and *in situ* (right).

Padina cf. moffittiana forms fan-shaped plants that are up to ~30 cm tall and attached to the substrate via a holdfast. The frond arises from the holdfast and stipes outward distally. The bases of plants are covered in stiff, rust colored, fibrous hairs.

***Padina* sp. 1**



Padina sp. 1 specimen photographed in the laboratory.

This species of *Padina* forms fan-like clusters. Blades are striated, circular and curved upwards towards the edges.

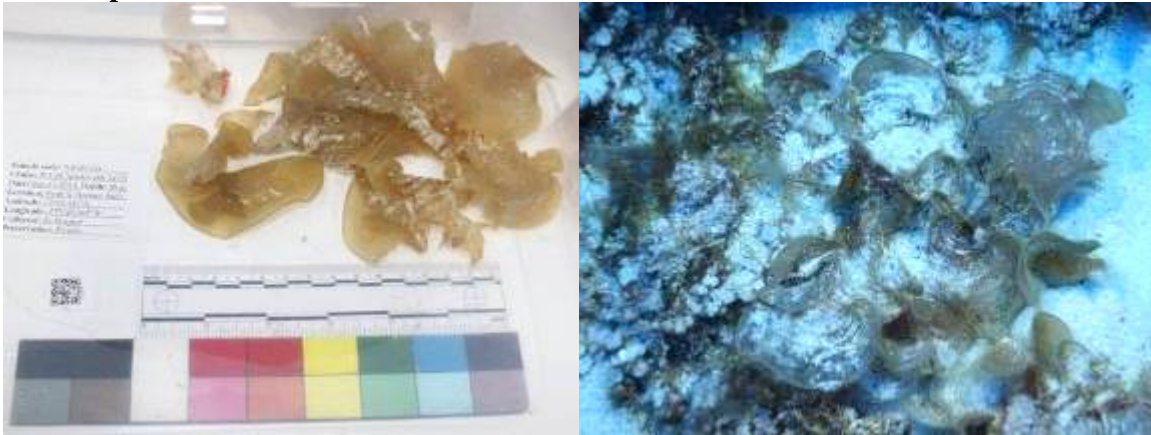
***Padina* sp. 2**



Padina sp. 1 specimen photographed in the laboratory.

This species forms fan-like clusters of small blades. The blades are striated, circular and curved upwards towards the edges.

***Padina* sp. 3**



Unidentified *Padina* specimen photographed in the laboratory (left) and *in situ* (right).

This species forms fan-like clusters of blades. The blades are striated, circular and curved upwards towards the edges and can often be covered with a thin layer of sediment.

***Dictyota ceylanica* Kützing, 1859**



Dictyota ceylanica specimen photographed in the laboratory (left) and *in situ* (right).

Dictyota ceylanica can be distinguished by branches that taper abruptly and are forked towards their apex. Plants can form a mixture of both narrow and wide fronds. *D. ceylanica* is light to medium brown in coloration and has variable iridescence. Plants can be up to ~6 cm in vertical height.

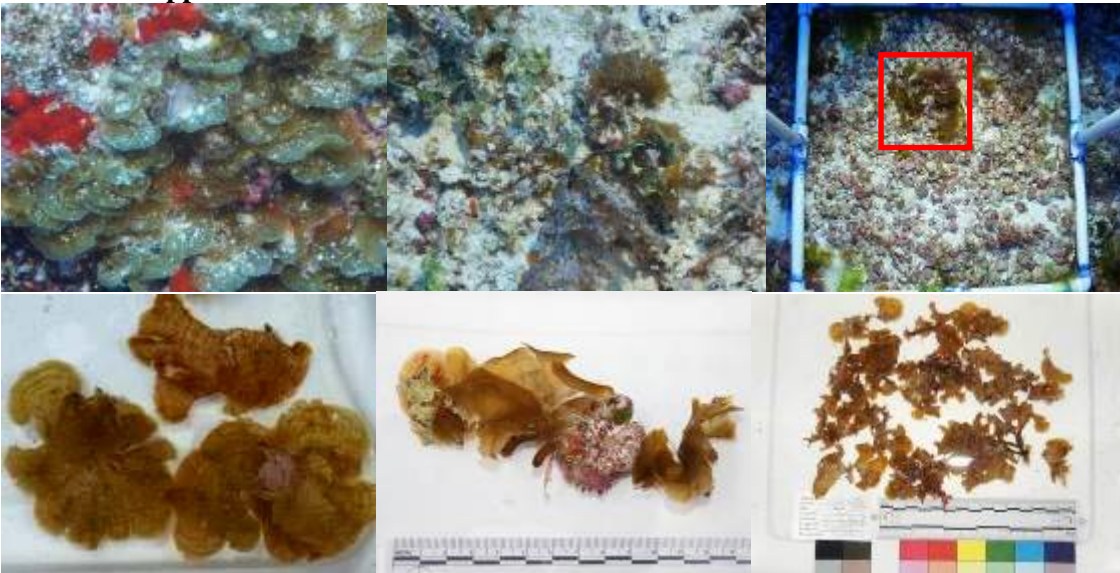
***Dictyopteris* sp.**



Unidentified *Dictyopteris* specimen photographed in the laboratory (left) and *in situ* (right).

Dictyopteris sp. has leaf-like branches that are light brown in coloration. Plants are dichotomously branching with flattened blades, and have a distinctive midrib. This species lacks the fine veins that typically extend from the midrib.

***Distromium* spp.**



Several species of *Distromium* photographed *in situ* (top) and laboratory (bottom).

Distromium sp. has brown, leaf-like blades that often grow in clusters or layered mats. Each blade is two cell layers thick. Molecular work suggests that there are at least three different species in this genus that have been collected from mesophotic depths in the Northwestern Hawaiian Islands. Unfortunately, none of these is yet distinguishable morphologically.

3.4.2 Order *Ectocarpales*

3.4.2.1 Family *Acinetosporaceae*

Feldmannia sp.



Unidentified *Feldmannia* specimen photographed in the laboratory (left) and *in situ* (right).

Feldmannia sp. grows on sandy bottoms. It is greenish-brown in coloration and composed of a dense cluster of filaments giving it a bushy appearance.

3.4.3 Order *Fucales*

3.4.3.1 Family *Sargassaceae*

Sargassum sp.



Unidentified *Sargassum* species photographed in the laboratory.

Sargassum sp. has brown, thick blades with ruffled edges and a tapered tip. This genus is typically found in the intertidal, but has recently been collected from mesophotic depths.

3.4.4 Order *Sporochnales*

3.4.4.1 Family *Sporochnaceae*

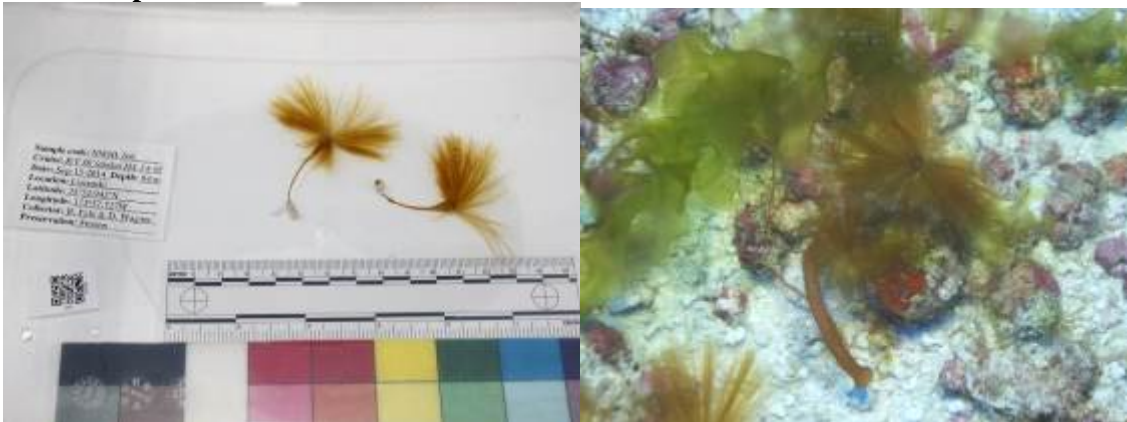
Sporochnus dotyi Brostoff, 1984



Sporochnus dotyi specimen photographed in the laboratory (left) and *in situ* (right).

Sporochnus dotyi is distinguished by a ring of thin hairs that look similar to cnidarian polyps, particularly from afar. Plants are attached to the substrate via a holdfast and grow erect reaching vertical heights of up to ~30 cm.

Bellotia? sp.



Unidentified *Bellotia?* specimens photographed in the laboratory (left) and *in situ* (right).

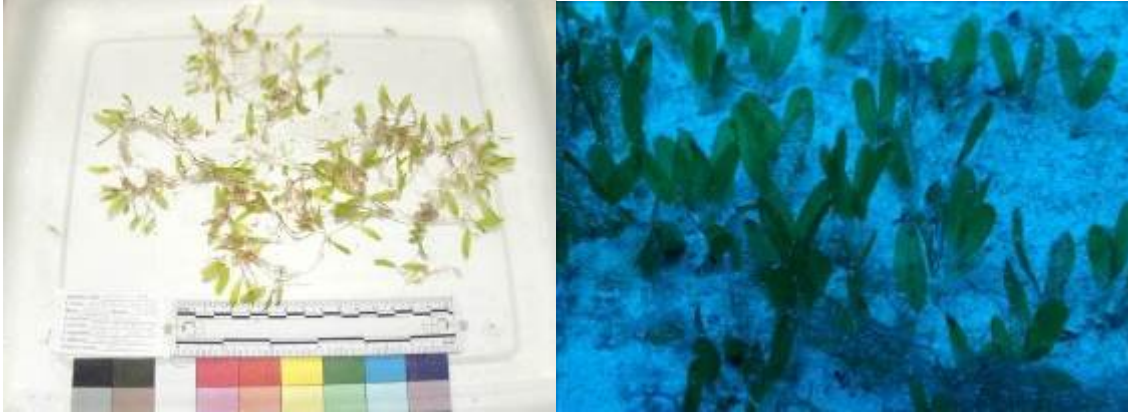
Morphologically this unidentified brown alga is most similar to members in the genus *Bellotia*. Molecular analyses are underway, which will determine the taxonomic affinities of this brown alga, which is distinguished by a single ring of thin hairs that look very similar to cnidarian polyps, particularly from afar.

3.5 Seagrasses

3.5.1 Order Alismatales

3.5.1.1 Family Hydrocharitaceae

Halophila decipiens Ostenfeld, 1902



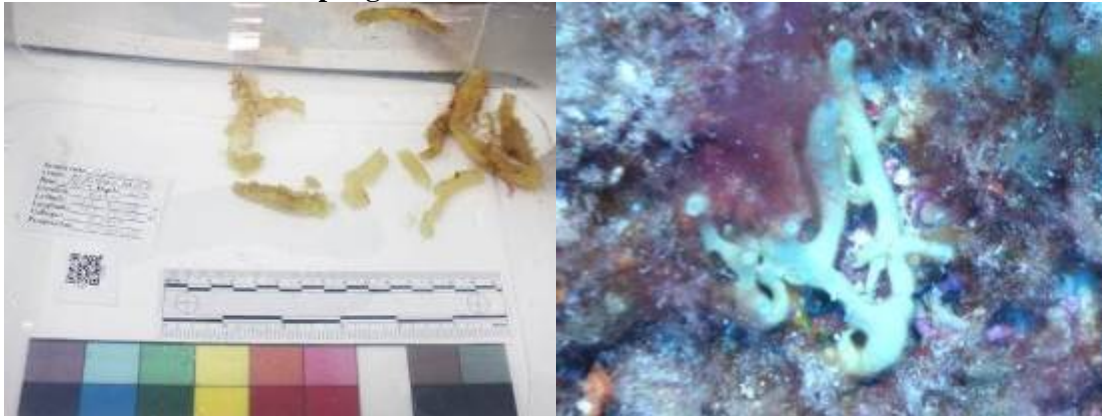
Halophila decipiens specimen photographed in the laboratory (left) and *in situ* (right).

Halophila decipiens forms plants with pairs of paddle-shaped leaves that form along a rhizome, which is in turn rooted in the sand. The leaves are 3-8 mm wide, and have a spinulose margin.

3.6 Sponges

3.6.1 Calcareous Sponges

Unidentified calcareous sponge



Unidentified calcareous sponge specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified calcareous sponge is yellowish-white *in situ*, and forms narrow tubes.

3.6.2 Demosponges, Order Agelasida

3.6.2.1 Family Hymerhabdiidae

Prosuberites sp.



Unidentified *Prosuberites* specimen photographed in the laboratory (left) and *in situ* (right).

Prosuberites sp. is bright orange *in situ* and is typically found encrusting shaded portions of the substrate. It has a bumpy and irregular surface. Its tissues are typically full of sand grains and may host colonies of crown jellyfish (*Nausithoe* sp.).

3.6.3 Demosponges, Order Axinellida

3.6.3.1 Family Axinellidae

Dragmacidon sp.



Unidentified *Dragmacidon* specimen photographed in the laboratory (left) and *in situ* (right).

Dragmacidon sp. is red or orange in coloration and forms bumpy mounds.

3.6.4 Demosponges, Order Chondrosiida

3.6.4.1 Family Chondrosiidae

Chondrosia cf. *chucalla* de Laubenfels, 1936



Unidentified *Chondrosia* specimen photographed in the laboratory (left) and *in situ* (right).

Chondrosia cf. *chucalla* is black or dark grey *in situ*, and has a smooth surface with large oscula. Colonies are firmly attached to the substrate.

Chondrosia sp.



Unidentified *Chondrosia* specimen photographed in the laboratory (left) and *in situ* (right).

Chondrosia sp. is black or dark brown *in situ*, and has a smooth surface. Colonies are firmly attached to the substrate.

3.6.5 Demosponges, Order Clionaida

3.6.5.1 Family Clionaidae

Sphaciospongia solida (Ridley & Dendy, 1886)



Sphaciospongia solida specimen photographed in the laboratory (left) and *in situ* (right).

Sphaciospongia solida is dark brown and grows in small mounds that have a distinctive osculum towards the top. This sponge lives buried in the sediment or in portions of hard substrate that is able to excavate. The tissues of this sponge contains remains of the excavated substrata it grows on.

3.6.6 Demosponges, Order Haplosclerida

3.6.6.1 Family Callyspongiidae

Arenosclera arabica (Keller, 1889)



Arenosclera arabica specimen photographed in the laboratory (left) and *in situ* (right).

Arenosclera arabica is tan or white in coloration and either straight or branched with distinct large oscula along its body. It has a reticulate surface made by the engulfed, foreign debris. It is quite soft and may host small crustaceans (Family Alpheidae).

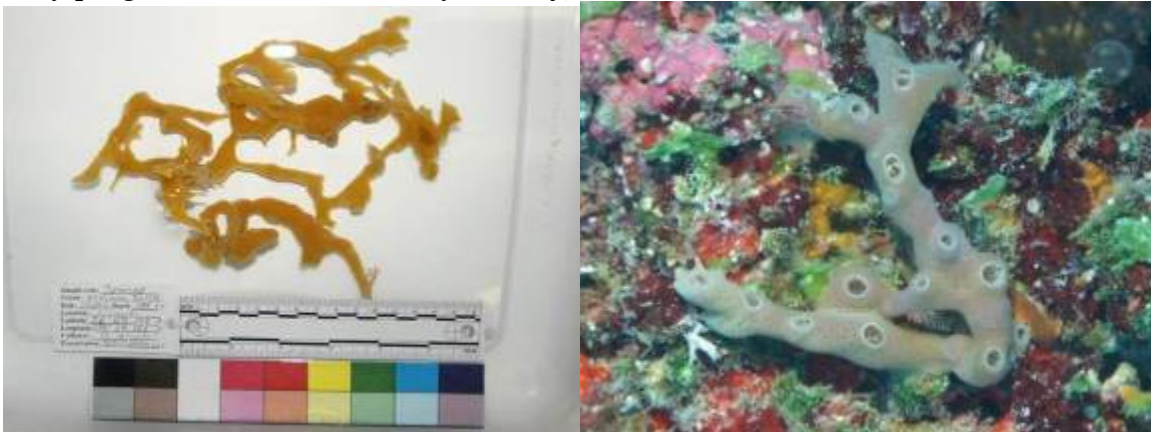
***Callyspongia* (*Cladochalina*) sp.**



Unidentified *Callyspongia* (*Cladochalina*) sp. specimen photographed in the laboratory (left) and *in situ* (right).

Callyspongia (*Cladochalina*) sp. is white or tan in coloration. It has a fuzzy appearance with a few larger crevices. It is spongy and elastic; a thin, smooth membrane covers its surface. It is typically found in shaded areas, such as underneath overhangs or inside caves.

***Callyspongia* (*Toxochalina*) cf. *ridleyi* (Dendy, 1905)**



Callyspongia cf. *ridleyi* specimen photographed in the laboratory (left) and *in situ* (right).

Callyspongia cf. *ridleyi* is tan or yellowish *in situ*. Colonies are branched with distinct, large oscula, slightly elevated, that have a lighter outer ring. This species grows in shaded areas, such as underneath overhangs or inside caves. It is very soft and spongy, and difficult to tear.

Unidentified sponge



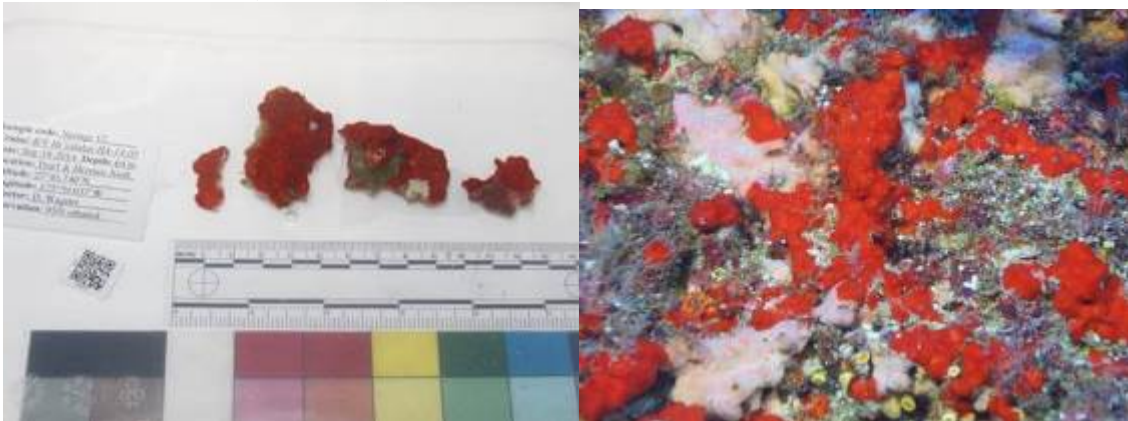
Unidentified sponge specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified sponge forms yellow or green mounds.

3.6.7. Demosponges, Order Poecilosclerida

3.6.7.1 Family Chondropsidae

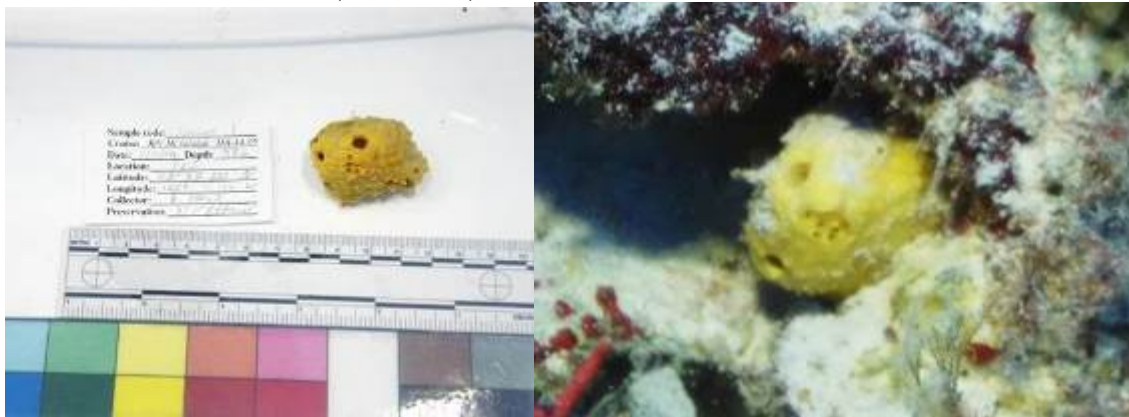
Batzella arautiaca (Lévi, 1958)



Batzella arautiaca specimen photographed in the laboratory (left) and *in situ* (right).

Batzella arautiaca is bright red when alive, and is found encrusting hard substrate in shaded areas of the reef. It forms a very thin incrustation on shaded areas.

***Psammoclema arenaceum* (Lévi, 1958)**



Psammoclema arenaceum specimen photographed in the laboratory (left) and *in situ* (right).

Psammoclema arenaceum is bright yellow when alive, and has a distinctly bumpy appearance. It is typically found inside holes or in other shaded portions of the reef. The tissue of this sponge is completely full of sediment, which makes the sponge quite fragile.

3.6.7.2 Family *Esperiopsidae*

***Ulosa rhoda* de Laubenfels, 1957**



Ulosa rhoda specimen photographed in the laboratory (left) and *in situ* (right).

Ulosa rhoda forms irregular shaped colonies with long cylindrical branches. Colonies are bright red *in situ* and have a bumpy appearance. The sponge is soft and elastic.

3.6.7.3 Family Tedaniidae

Tedaniidae

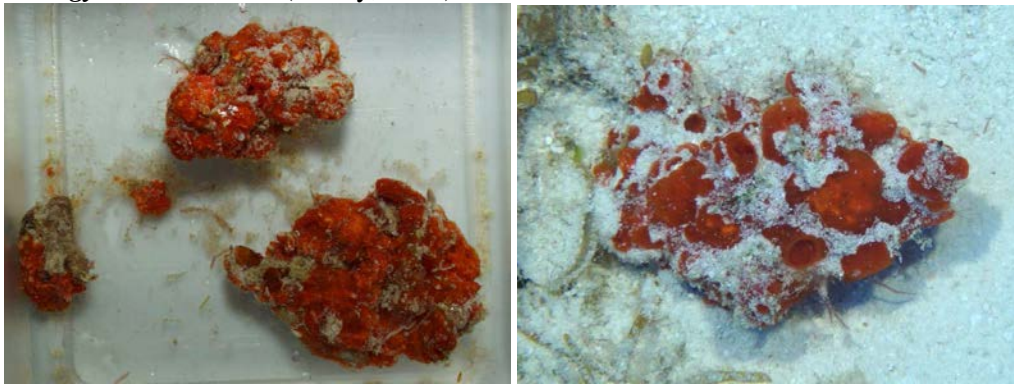
Tedania brevispiculata Thiele, 1903



Tedania brevispiculata specimen photographed in the laboratory (left) and *in situ* (right).

Tedania brevispiculata is brown or black in coloration and has large oscula. It encrusts hard substrates and has a smooth appearance.

Strongylamma wilsoni (Dendy, 1922)



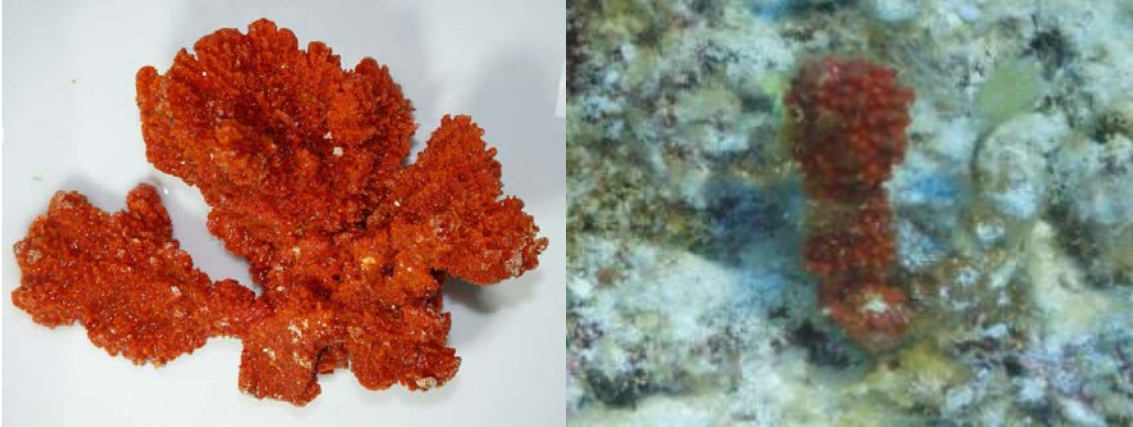
Strongylamma wilsoni specimen photographed in the laboratory (left) and *in situ* (right).

Strongylamma wilsoni forms thin encrusting colonies that are bright red *in situ*. Colonies have an irregular appearance, with many bumps and small oscula.

3.6.8 Demosponges, Order Scopalinida

3.6.8.1 Family Scopalinidae

Stylissa carteri (Dendy, 1889)



Stylissa carteri specimen photographed in the laboratory (left) and *in situ* (right).

Stylissa carteri is bright red *in situ* with distinct conules on its surface. Colonies can be straight or branched.

3.6.9 Demosponges, Order Suberitida

3.6.9.1 Family Halichondriidae

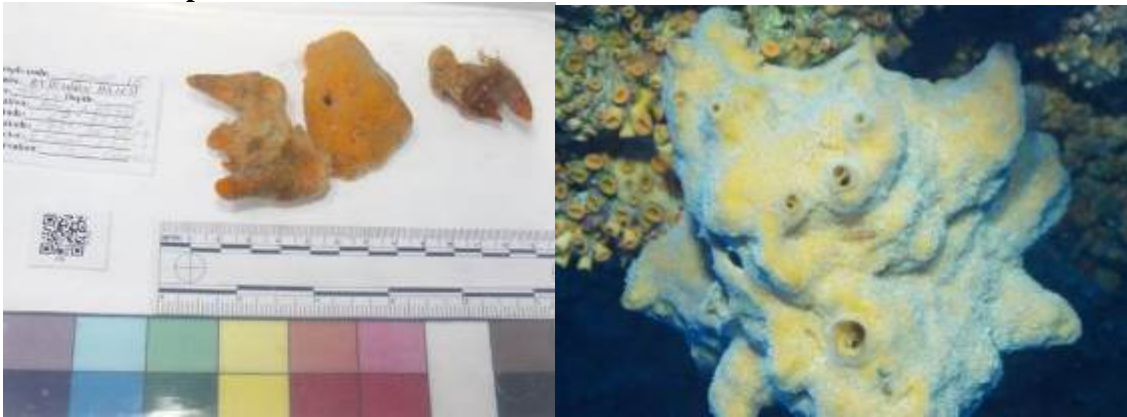
Epipolasis sp. (probably a new species)



Unknown *Epipolasis* specimen photographed in the laboratory (left) and *in situ* (right).

Epipolasis sp. is yellowish-grey *in situ*. It is very soft and fragile, and its tissues often contain a lot of foreign debris.

***Halichondria* sp.**



Unidentified *Halichondria* specimen photographed in the laboratory (left) and *in situ* (right).

Halichondria sp. looks light yellow in the water and has large oscula. It is found in caves, under overhangs or in other shaded portions of the reef.

3.7 Polychaetes

3.7.1 Order Sabellida

3.7.1.1 Family Sabellidae

***Sabellastarte spectabilis* (Grube, 1878)**



Sabellastarte spectabilis specimens photographed *in situ*.

Sabellastarte spectabilis has a leathery tube that enclose the crown. The entire body of the worm is beige colored with flecks of purple pigment. It can attain sizes up to 8 cm in height. This species is introduced to the Hawaiian Islands and is the only non-indigenous invertebrate recorded during mesophotic surveys in the Northwestern Hawaiian Islands to date.

3.8 Bryozoans

3.8.1 Order Cheilostomatida

3.8.1.1 Family Myriaporidae

Myriozoum honolulense Busk, 1884

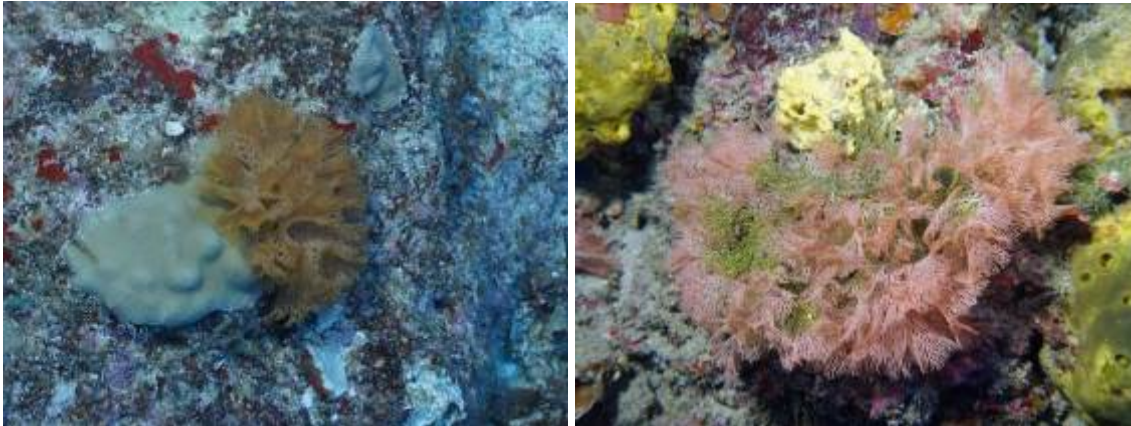


Myriozoum honolulense specimen photographed in the laboratory (left) and *in situ* (right).

Myriozoum honolulense forms finely branching colonies that branch dichotomously. Colonies are pink or beige in coloration.

3.8.1.2 Family Phidoloporidae

Reteporellina denticulata (Busk, 1884)



Reteporellina denticulata specimen photographed *in situ*.

Reteporellina denticulata, commonly known as the lace bryozoan, has fine, yellowish-tan or pink interconnected branches that break easily. It has calcareous branches and can therefore be mistaken for a delicate coral.

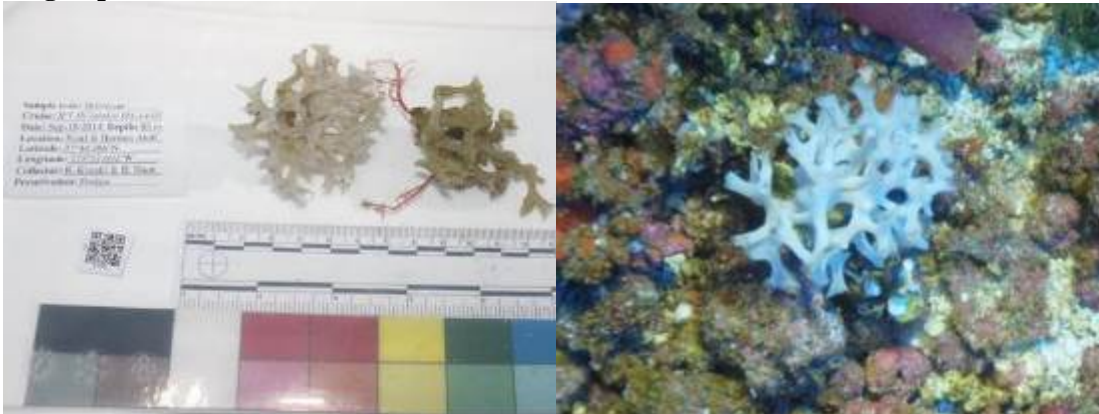
***Triphyllozoon* sp.**



Triphyllozoon specimen photographed *in situ*.

This bryozoan forms fragile ruffles. Its lacy folds are covered with a mesh pattern.

**3.8.1.3 Family *Steginoporellidae*
*Steginoporellidae***



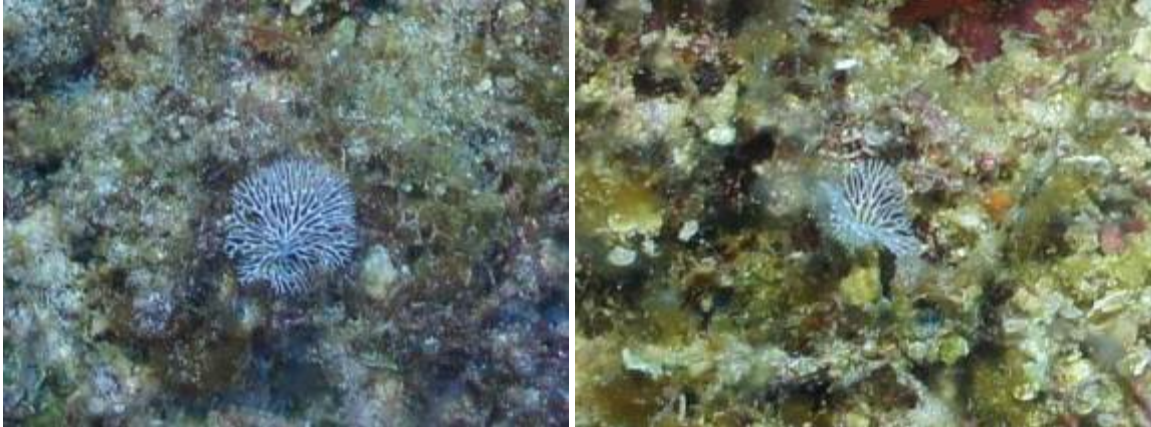
A *Steginoporellidae* specimen photographed in the laboratory (left) and *in situ* (right).

Steginoporellidae is a white bryozoan that branches dichotomously.

3.8.2 Order Cyclostomatida

3.8.2.1 Family Crisinidae

Mesonea radians (Lamarck, 1816)



Mesonea radians specimens photographed *in situ*.

This fragile calcareous bryozoan forms fan-like colonies with branches that radiate outward from the center.

3.8.3 Unidentified Bryozoans

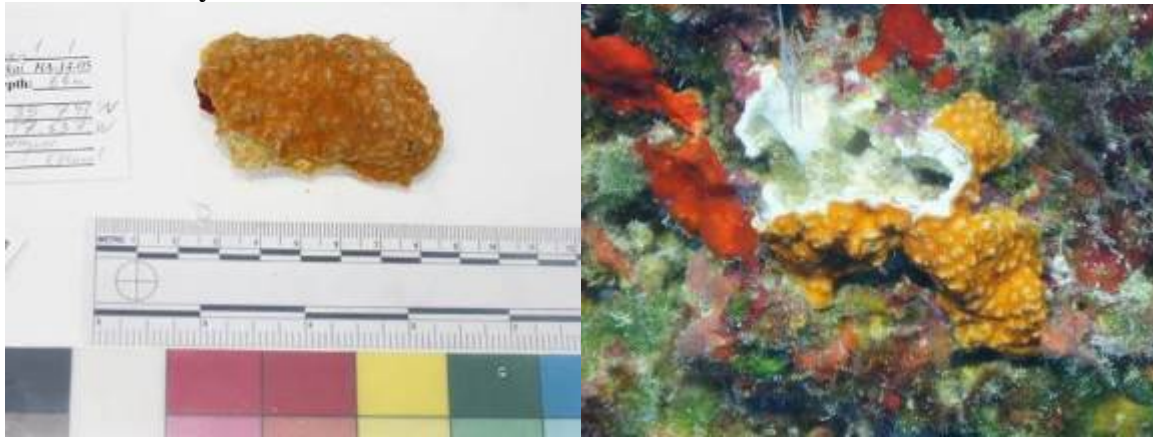
Unidentified bryozoan



Unidentified bryozoan specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified bryozoan is orange-brown in coloration, and forms irregular branches. A specimen was collected in 2013, but has not yet been identified by a taxonomic authority.

Unidentified bryozoan



Unidentified bryozoan specimen photographed in the laboratory (left) and *in situ* (right).

This unidentified bryozoan is orange in coloration, and forms small bumps. A specimen was collected in 2013, but has not yet been identified by a taxonomic authority.

3.9 Hydroids

3.9.1 Order Anthoathecata

3.9.1.1 Family Solanderiidae

Solanderia secunda (Inaba, 1892)



Solanderia secunda specimen photographed in the laboratory (left) and *in situ* (right).

Solanderia secunda, commonly known as the sea fan hydroid, forms stiff, branching colonies that resemble small sea fans.

3.9.2 Order Leptothecata

3.9.2.1 Family Aglaopheniidae

Macrorhynchia balei (Nutting, 1906)



Macrorhynchia balei specimen in the laboratory (left) and *in situ* (right).

Macrorhynchia balei forms planar, and pinnately branching colonies that are firmly attached to the substrate.

Macrorhynchia hawaiiensis (Nutting, 1906)



Macrorhynchia hawaiiensis specimen in the laboratory (left) and *in situ* (right).

Macrorhynchia hawaiiensis forms planar, and pinnately branching colonies that are firmly attached to the substrate. Colonies are typically found in shaded portions of the reef, such as inside crevices or under overhangs.

Lytocarpia niger (Nutting, 1905)

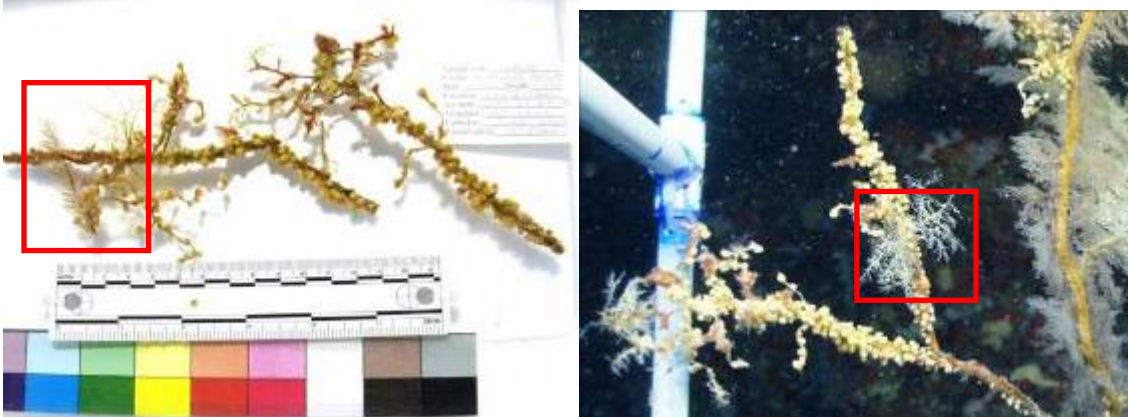


Lytocarpia niger specimen photographed *in situ*.

Lytocarpia niger, commonly known as black hydroid, is dark brown or black with many feather-like branches. Colonies can reach vertical heights of 5 cm or more and be extensively branched.

3.9.2.2 Family Campanulariidae

Rhizocaulus eloisa (Nutting, 1905)



Rhizocaulus eloisa specimen photographed in the laboratory (left) and *in situ* (right).

Rhizocaulus eloisa is a white branching hydroid. It is usually found growing under ledges or in shaded areas, as well as overgrowing black corals.

3.9.2.3 Family Sertulariidae

Sertularella diaphana (Allman, 1885)

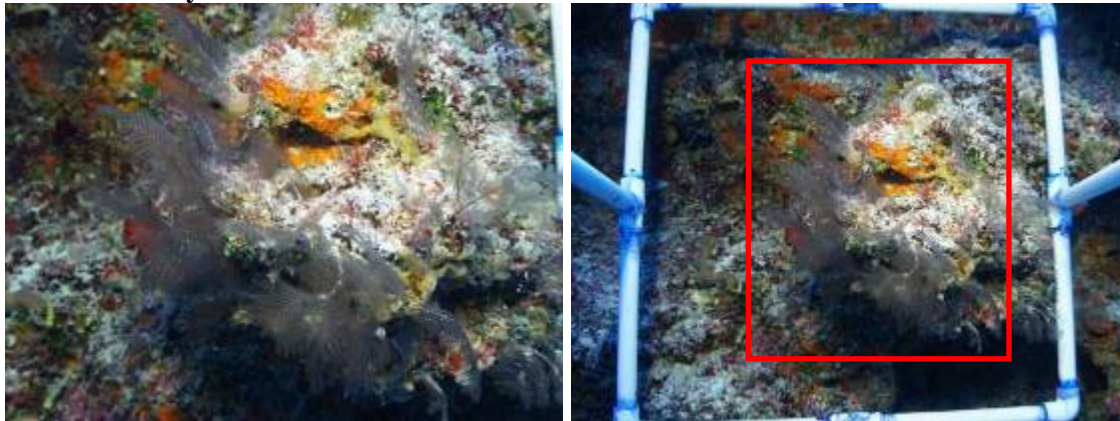


Sertularella diaphana specimen photographed in the laboratory (left) and *in situ* (right).

Sertularella diaphana, also known as diaphanous hydroid, forms white colonies that are finely branched. It commonly occurs in shaded portions of mesophotic reefs, such as inside caves, arches, or under overhangs.

3.9.3 Unidentified Hydroids

Unidentified hydroid



Unidentified specimen photographed in *in situ*.

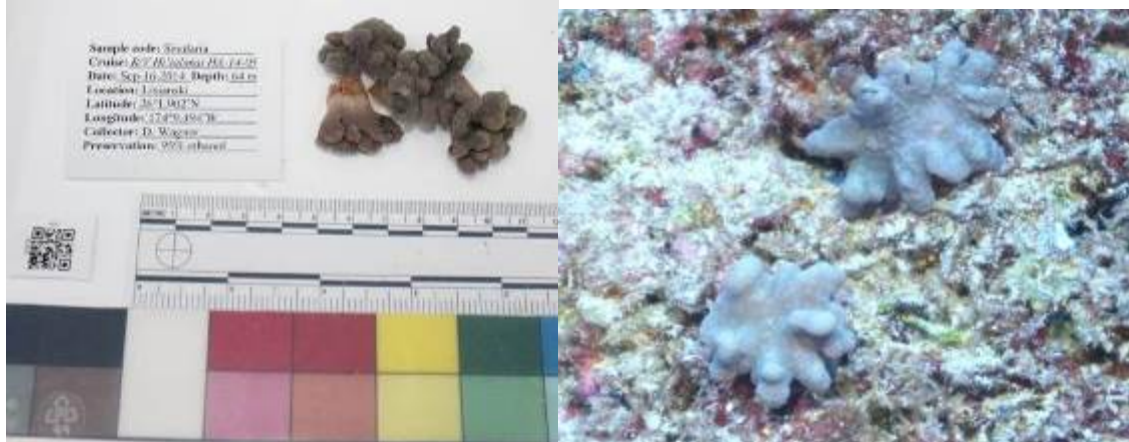
This unidentified black hydroid has feather-like branches.

3.10 Octocorals

3.10.1 Order Alcyonacea

3.10.1.1 Family Alcyoniidae

Sinularia sp.



Unidentified *Sinularia* sp. specimen photographed in the laboratory (left) and *in situ* (right).

Sinularia sp. looks pink or brown *in situ*. It grows in little mounds with finger-like projections.

3.10.1.2 Family Melithaeidae

Melithaea bicolor (Nutting, 1908)



Melithaea bicolor specimens photographed in the laboratory (left) and *in situ* (right).

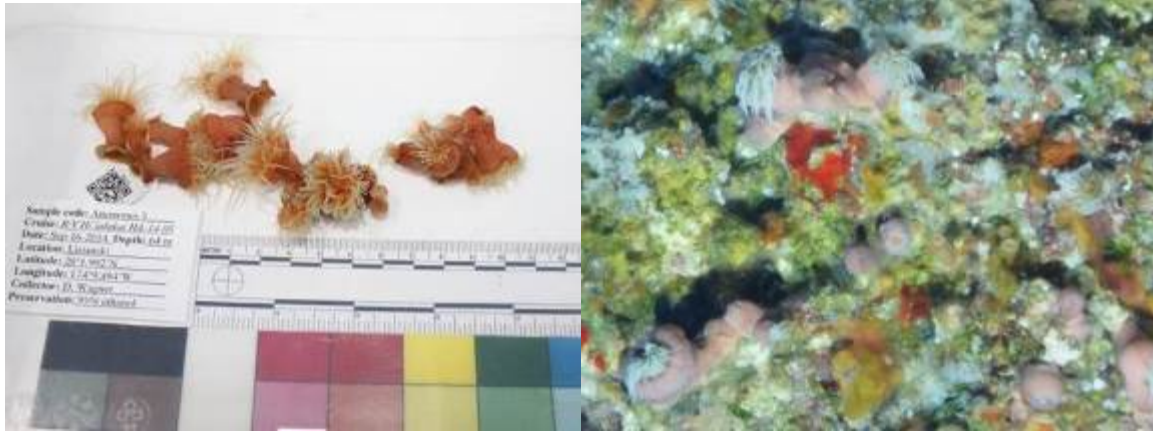
Melithaea bicolor, also known as the bicolor gorgonian, branches with parallel polyps. It is usually bright red, orange or yellow, but may also be pink or white.

3.11 Anemones

3.11.1 Order Actinaria

3.11.1.1 Family Actiniidae

Anemonia mutabilis Verrill, 1928



Anemonia mutabilis specimen photographed in the laboratory (left) and *in situ* (right).

Anemonia mutabilis is a pinkish tan anemone with white tentacles.

3.11.1.2 Family Aliciidae

Alicia mirabilis Johnson, 1861

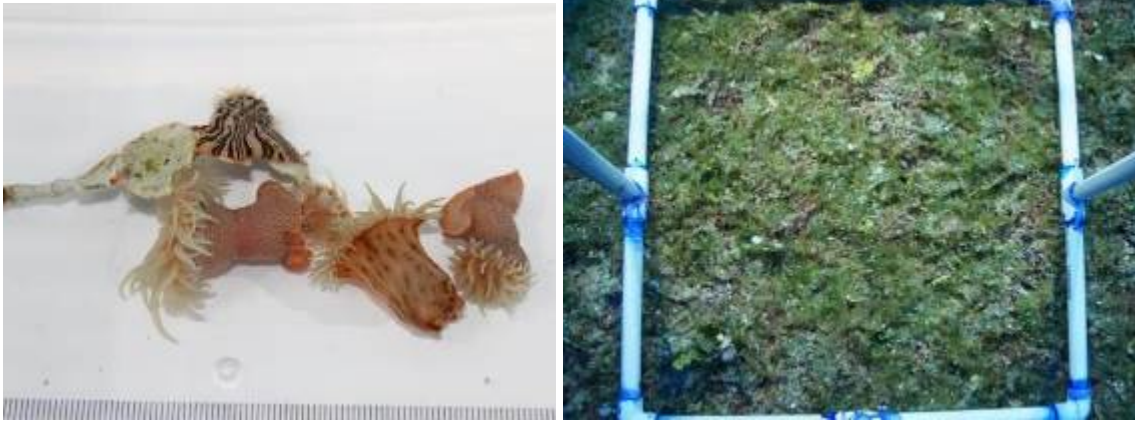


Alicia mirabilis specimen photographed in the laboratory (left) and *in situ* (right).

Alicia mirabilis forms large colonies that can be as tall as 40 cm. Its polyps have long tentacles.

3.12.1.3 Family Nemanthidae

***Nemanthus* sp.**



Unidentified *Nemanthus* specimen photographed in the laboratory (left) and *in situ* (right).

Nemanthus sp. is a pinkish tan anemone with white tentacles

3.12.1.4 Family Stichodactylidae

***Heteractis malu* (Haddon & Shackleton, 1893)**

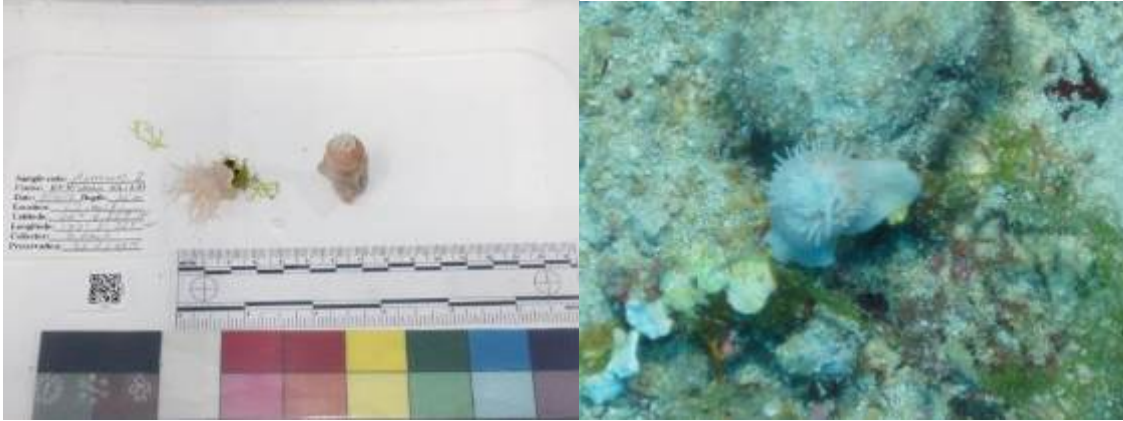


Heteractis malu photographed *in situ*.

Heteractis malu, commonly called the sand anemone, forms large polyps that are tan or light brown in coloration. It may be buried in the sand with only a pale crown of tentacles exposed. Polyps may be over 15 cm in diameter or larger.

3.11.2 Unidentified Anemones

Unidentified anemone



Unidentified anemone photographed in the laboratory (left) and *in situ* (right).

This unidentified anemone has pink or tan colored polyps and white tentacles.

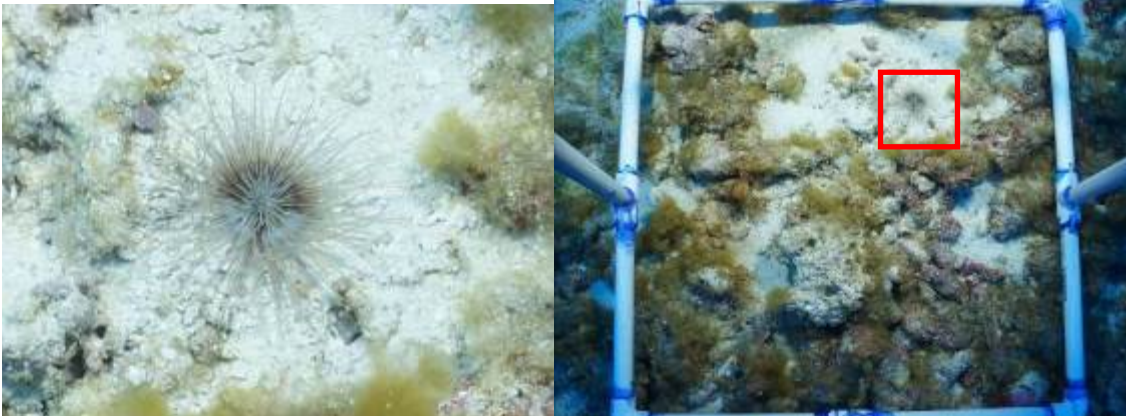
Unidentified anemone



Unidentified anemone photographed in the laboratory (left) and *in situ* (right).

This unidentified anemone has white tentacles and brown and tan bands on the main body.

Unidentified anemone



Unidentified anemone photographed *in situ*.

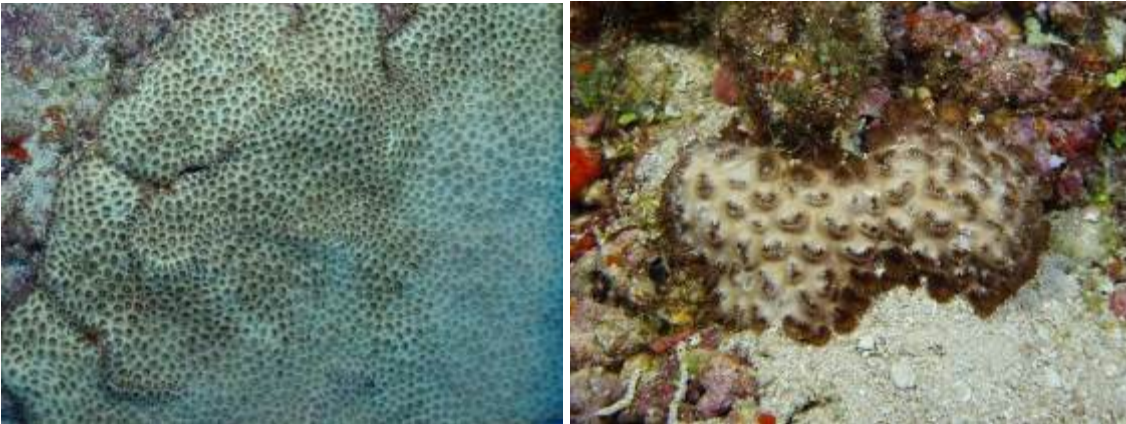
This unidentified anemone has long tentacles. No specimens of this species have been collected to date.

3.12 Zoanthids

3.12.1 Order Zoantharia

3.12.1.1 Family Sphenopidae

Palythoa caesia Dana, 1846



Palythoa caesia specimen photographed *in situ*.

Palythoa caesia, commonly known as pillow zoanthid, forms tough mats on rocks and dead coral. It may appear smooth and featureless when the polyps are closed. It is light blueish gray, but may also appear on various shades of pinks, brown, and green.

3.12.1.2 Family Parazoanthidae

Parazoanthus sp.



Unidentified *Parazoanthus* specimen photographed in the laboratory (left) and *in situ* (right).

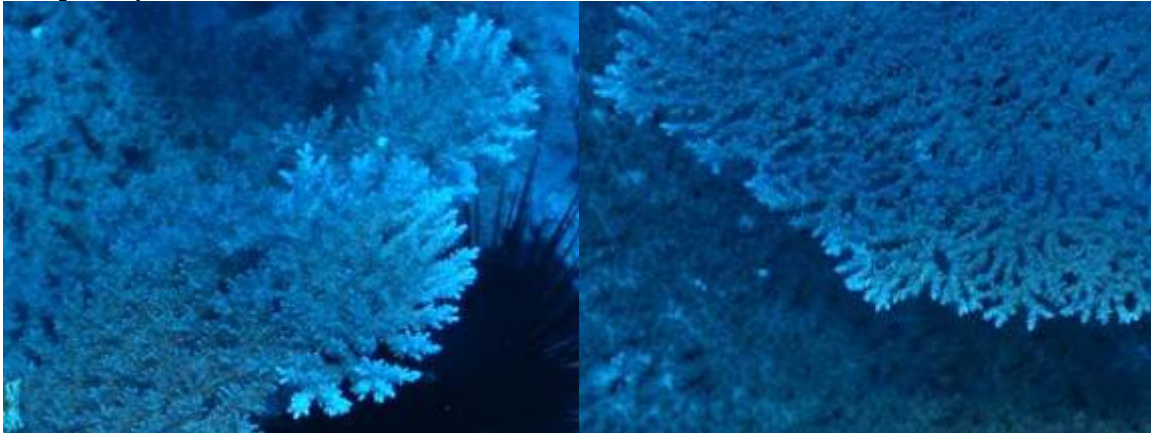
Parazoanthus sp. forms fleshy knobs that can encrust dead portions of corals.

3.13 Scleractinian Corals

3.13.1 Order Scleractinia

3.13.1.1 Family Acroporidae

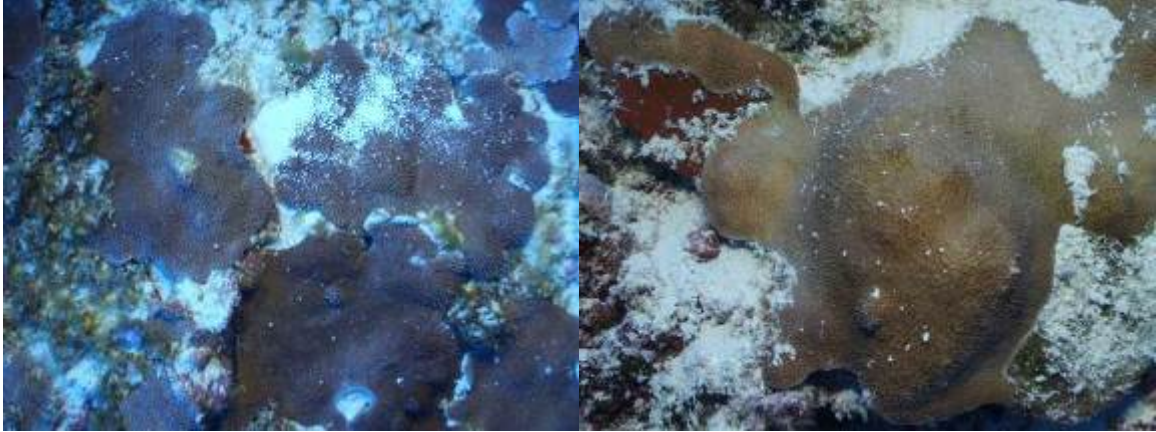
Acropora cytherea Dana, 1846



Acropora cytherea specimen photographed *in situ*.

Acropora cytherea forms tables, each with a central stalk and a flat, circular surface. The surface is covered with short, thin, spike like vertical bracelets. This species is usually found in shallow-water (<30m) reefs of the Northwestern Hawaiian Islands, but is also sometimes found below these depths.

Montipora capitata Dana, 1846

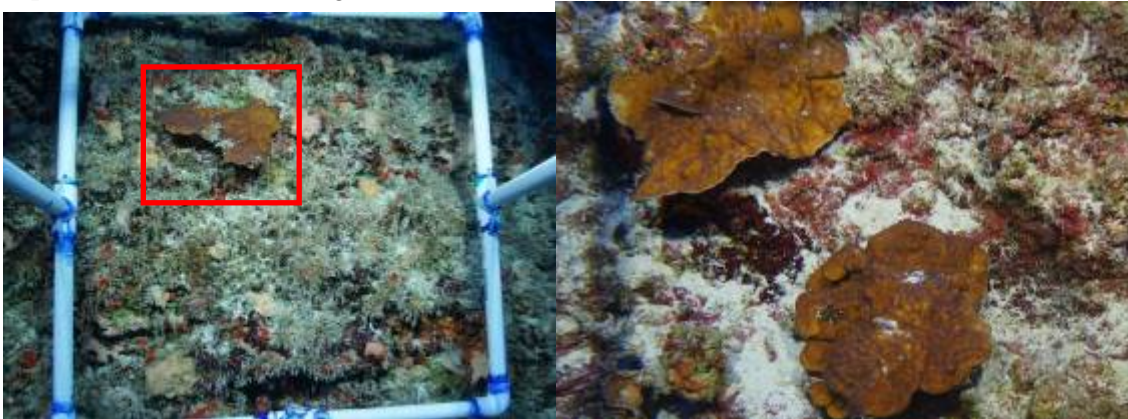


Montipora capitata specimen photographed *in situ*.

Montipora capitata, commonly called the rice coral, grows in a variety of forms from plate-like to branching. It is typically encrusting, but also forms massive colonies with broad plates or cups. On deeper coral reefs, this species almost exclusively forms encrusting colonies. The color of colonies ranges from dark brown to beige or cream with light edges and tips.

3.13.1.2 Family Agariciidae

Leptoseris hawaiiensis Vaughan, 1907



Leptoseris hawaiiensis specimen photographed *in situ*.

Leptoseris hawaiiensis, commonly known as the Hawaiian plate coral, forms encrusting plates or elevated funnels that range from medium to dark brown. Corallites are often tilted or pointed outward and are never joined in a series.

Leptoseris incrustans (Quelch, 1886)



Leptoseris incrustans specimen photographed in the laboratory.

Leptoseris incrustans, commonly known as the swelling coral, is an encrusting coral that has many swellings between sunken calyces. The swellings are covered with wavy ridges. Colonies vary in color from greenish to reddish brown.

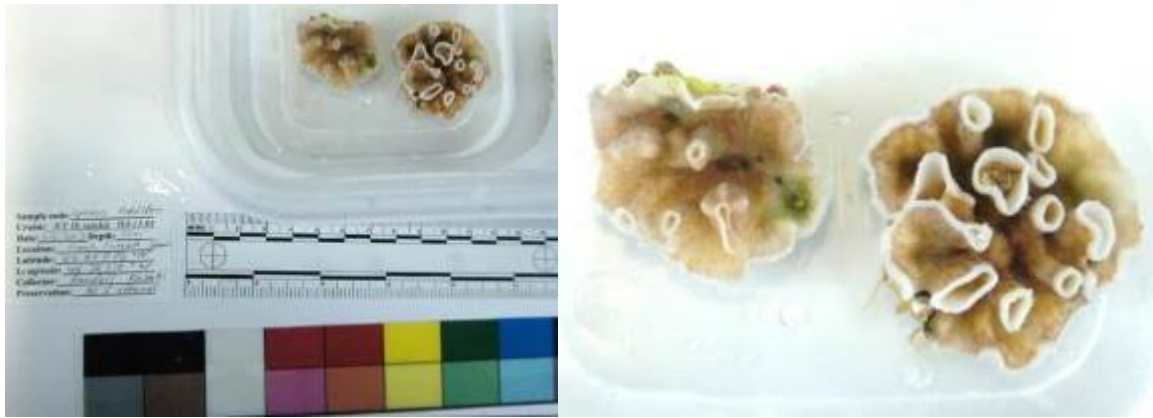
Leptoseris mycetoseroides Wells, 1954



Leptoseris mycetoseroides specimen photographed in the laboratory (left) and *in situ* (right).

Leptoseris mycetoseroides forms encrusting gray or brown sheets with rounded ridges going in all directions. Colonies can be either green or light brown and extend horizontally over large areas.

Leptoseris tubulifera Vaughan, 1907



Leptoseris tubulifera specimens photographed in the laboratory.

Leptoseris tubulifera, commonly known as the tube coral, forms small yellow or brown colonies that often have white edges. Colonies are smooth and composed of thin plates with curled up edges. *L. tubulifera* colonies are small and typically do not exceed 5-8 cm in diameter.

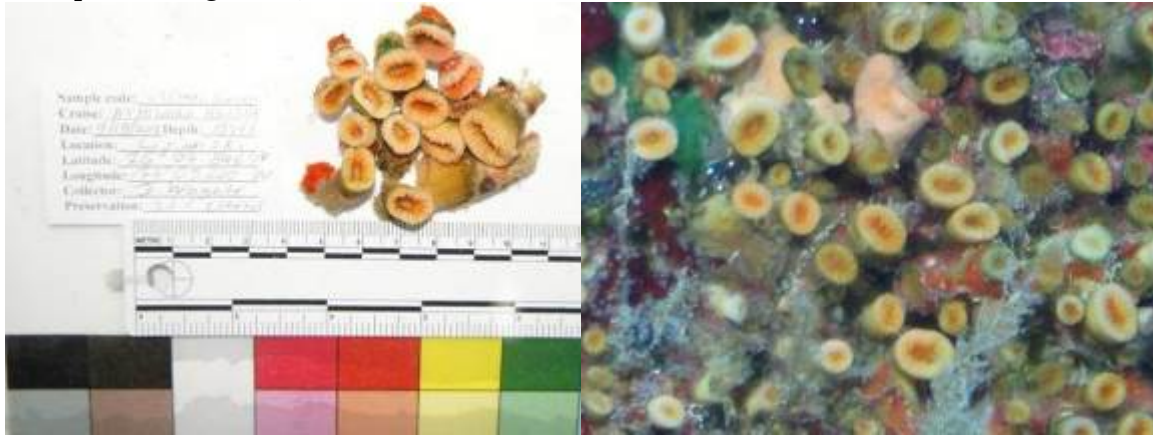
Leptoseris sp.



Unidentified *Leptoseris* sp. photographed in the laboratory (left) and *in situ* (right).

This unidentified *Leptoseris* sp. builds colonies that branch upwards towards the outer edges. Colonies are tan or brown *in situ* with white edges.

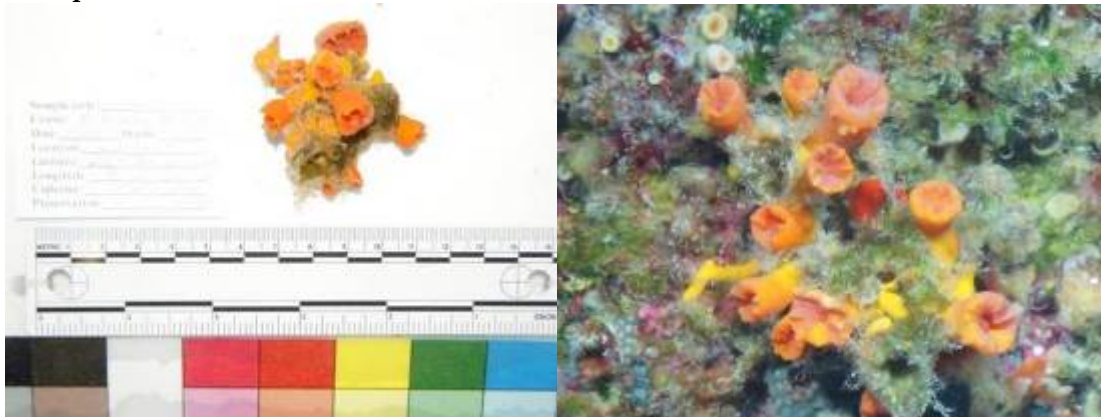
3.13.1.3 Family Dendrophylliidae
***Cladopsammia eguchii* (Wells, 1972)**



Cladopsammia eguchii specimen photographed in the laboratory(left) and *in situ* (right).

Cladopsammia eguchii forms yellowish colonies that are orange in the center where the soft tissues lie. This coral is a solitary species, with individuals composed of a single polyp. This species typically contracts its tentacles during the day and has expanded polyps at night. *C. eguchii* grows on shaded portions of the reef, such as inside caves, underneath overhangs or on steep vertical walls.

***Rhizopsammia verrilli* van der Horst, 1922**

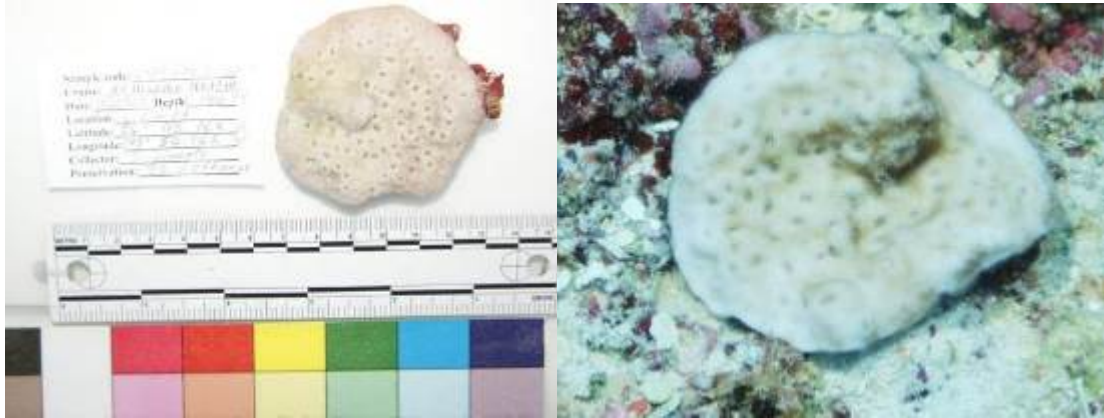


Rhizopsammia verrilli specimen photographed in the laboratory (left) and *in situ* (right).

Rhizopsammia verrilli forms a single orange tubular corallite that is often found close to other corallites. It is a dark orange when alive. This solitary coral typically is found on shaded portions of the reef, such as inside caves, underneath overhangs or on steep vertical walls.

3.13.1.4 Family Fungiidae

***Cycloseris wellsi* (Veron and Pichon, 1980)**

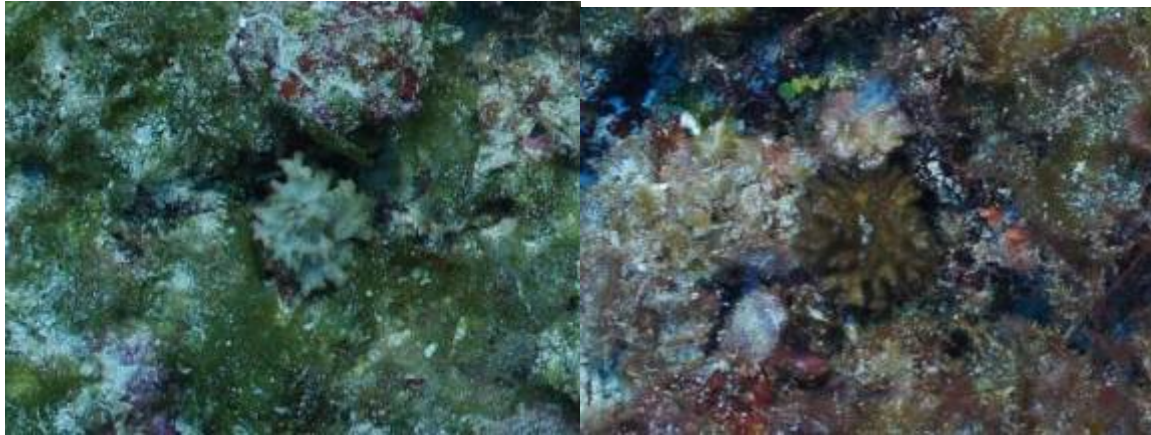


Cycloseris wellsi specimen photographed in the laboratory (left) and *in situ* (right).

Cycloseris wellsi, commonly known as wells' coral, forms light pink or cream encrusting colonies. The corallites look like small pits on the surface. There are tiny ridges between polyps.

3.13.1.5 Family Pocilloporidae

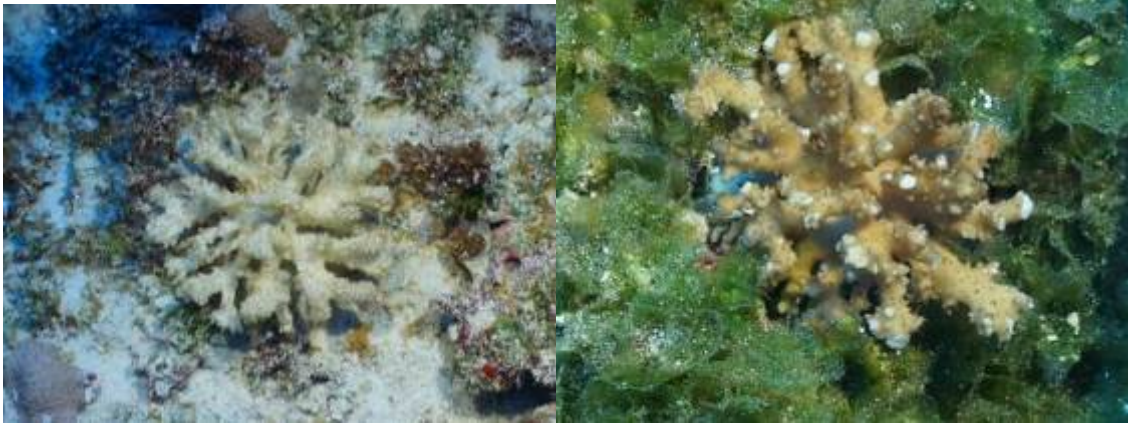
***Pocillopora damicornis* (Linnaeus, 1758)**



Pocillopora damicornis specimen photographed *in situ*.

Pocillopora damicornis, commonly known as the lace coral, forms small, bushy heads that have slender and delicate branches. The branches are typically shorter and thicker in turbulent areas. Wart-like bumps sometimes grow at the tips. Colonies are light brown or brown in coloration.

Pocillopora ligulata Dana, 1846



Pocillopora ligulata specimen photographed *in situ*.

Pocillopora ligulata has a cauliflower-like branching pattern with fuzzy polyps. The branches are flattened and give rise to white tips.

Pocillopora meandrina Dana, 1846



Pocillopora meandrina specimens photographed *in situ*.

Pocillopora meandrina, commonly known as the cauliflower coral, forms compactly branching colonies. It has flattened branches that are usually equal in length and may be c-shaped at the tip. The color can range from brownish to green or pink.

3.13.1.6 Family Poritidae

***Porites compressa* Dana, 1846**



Porites compressa specimen photographed *in situ*.

Porites compressa, commonly known as the finger coral, forms finger-like branches with tips that are usually blunt or flattened. Colonies are light brown or yellow in coloration.

***Porites lobata* Dana, 1846**

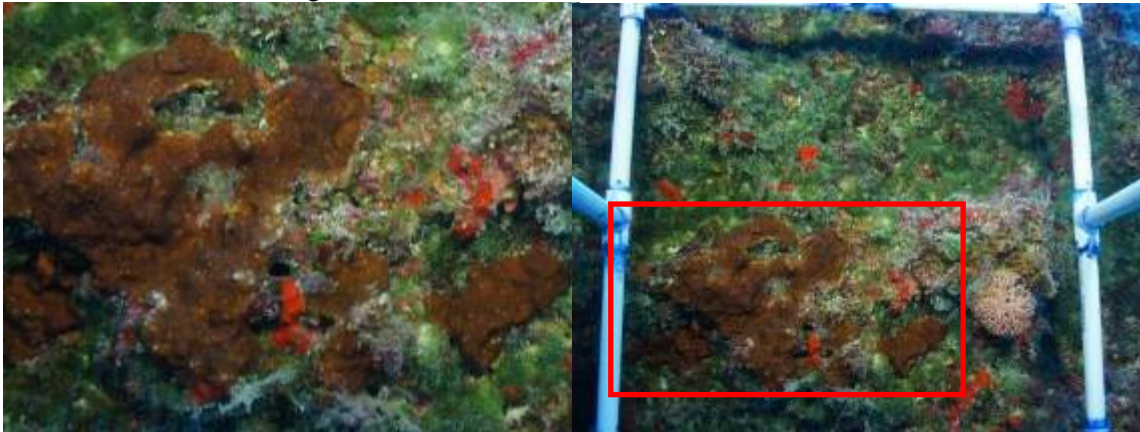


Porites lobata specimen photographed *in situ*.

Porites lobata, commonly known as the lobe coral, varies greatly in size and shape. It is generally encrusting in shallow or turbid waters. It can form huge mounds of 3 m or higher. Color varies from yellowish brown to yellowish green.

3.13.1.7 Family Psammocoridae

***Psammocora verrilli* Vaughan, 1907**



Psammocora nierstraszi specimen photographed *in situ*.

Psammocora verrilli, commonly known as the sandpaper coral, forms encrusting yellow-green, brown, or purple colonies with small ridges. The surface appears smooth between the ridges.

***Psammocora stellata* (Verrill, 1866)**



Psammocora nierstraszi specimen photographed in the laboratory.

Psammocora stellata, commonly known as the stellar coral, forms small, branching tan, rust, gray, purple, or light green colonies with pinhole pits scattered over the otherwise smooth surface. Colonies can either have an encrusting or a branching growing pattern.

3.13.1.8 Family Scleractinia incertae sedis

***Leptastrea purpurea* (Dana, 1846)**



Leptastrea purpurea specimen photographed *in situ*.

Leptastrea purpurea forms flat encrusting colonies. Calyces are greenish brown and often whitish in the center. The corallites are fairly uniform in size throughout the colonies. Colonies are usually pale yellow in coloration.

3.14 Black Corals

3.14.1 Order Antipatharia

3.14.1.1 Family Antipathidae

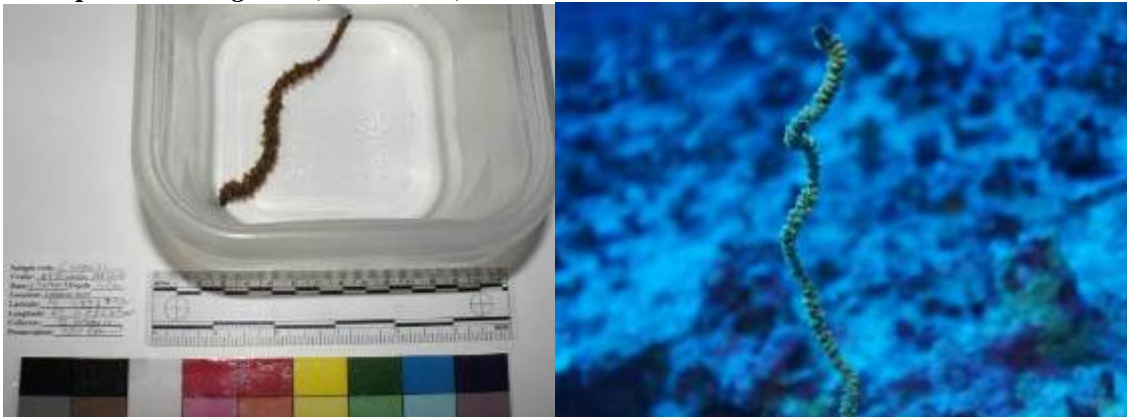
***Antipathes griggi* Opresko, 2009**



Antipathes griggi specimen photographed in the laboratory (left) and *in situ* (right).

Antipathes griggi is extensively branched and its tissues range between brown, red and orange in coloration. On the lower part of colonies, branches are arranged all around the colony like a bush. Branches become more planar on the distal parts of colonies.

Cirrhopathes cf. anguina (Dana, 1846)



Cirrhopathes anguina specimen photographed in the laboratory (left) and *in situ* (right).

Cirrhopathes cf. anguina, commonly known as whip coral, consists of a single long stem that can reach heights of 2 m or more. Smaller colonies are typically straight, and larger colonies become more irregularly sinusoidal. The coenenchyme is typically brown in coloration, and the tentacles can range between yellow, green, red, white and pink. Polyps appear on two or more sides of the stem.

***Stichopathes?* sp.**



Unidentified *Stichopathes* sp. specimen photographed in the laboratory (left) and *in situ* (right).

Stichopathes? sp. colonies can reach extreme heights of 5 m or more. The corallum of small colonies is typically straight, and becomes more irregularly sinusoidal or spiraled in larger colonies. Living colonies range in coloration between brown and greenish-brown.

3.14.1.2 Family *Myriopathidae*

Myriopathes cf. *ulex* (Ellis & Solander, 1786)



Myriopathes ulex specimen photographed in the laboratory (left) and *in situ* (right).

Myriopathes cf. *ulex* forms fan-shaped colonies that can reach massive heights of 3 m or more. Colonies consist of numerous feather-like branchlets or pinnules. The color of living colonies ranges between brown, orange, pale-red and white.

3.15 Urchins

3.15.1 Order *Diadematoida*

3.15.1.1 Family *Diadematidae*

Diadema paucispinum (A. Agassiz, 1863)



Diadema paucispinum specimens photographed *in situ* (right).

Diadema paucispinum, commonly known as the long-spined urchin, has long purplish black spines that are up to several times the diameter of the test. Juveniles have purplish-red spines.

***Diadema* sp.**



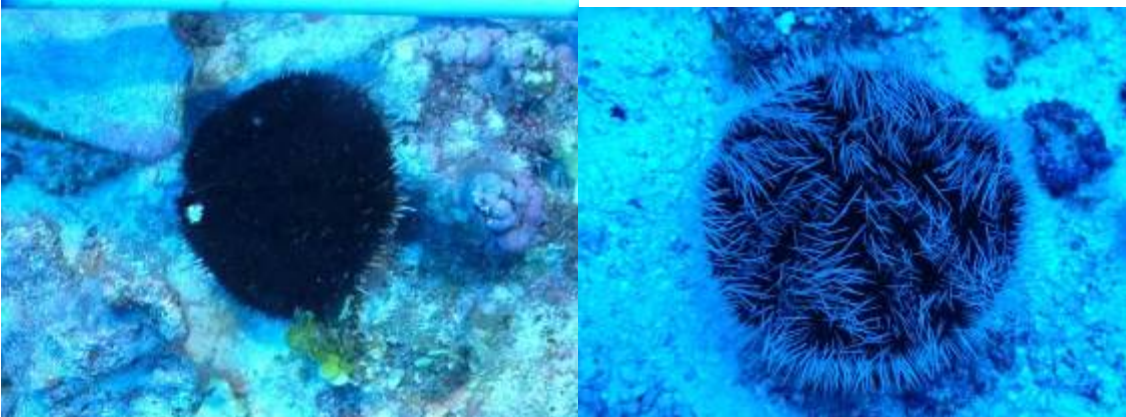
Unidentified *Diadema* sp. specimen photographed *in situ*.

Diadema sp. forms long, red spines that extend from a pink center. The length of the spines is typically much longer than the diameter of the test.

3.15.2 Order Camarodonta

3.15.2.1 Family Toxopneustidae

***Tripneustes gratilla* (Linnaeus, 1758)**

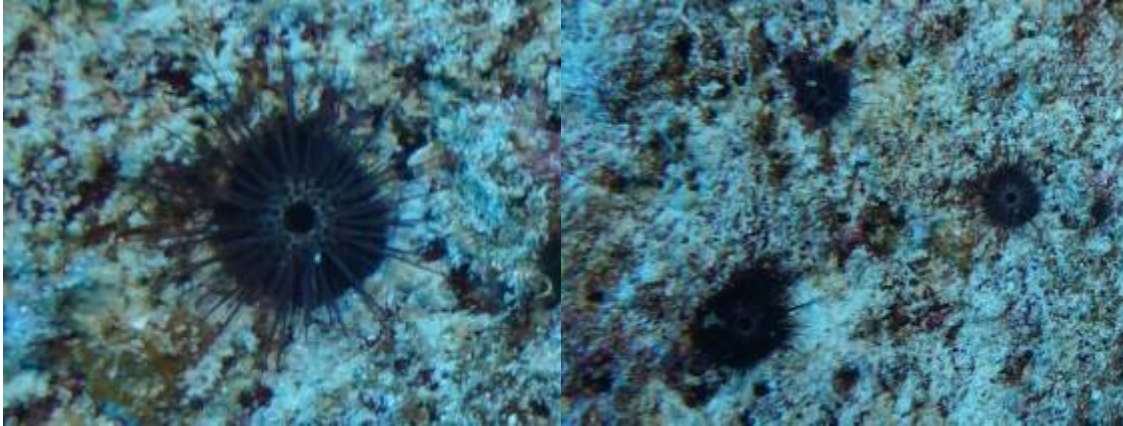


Tripneustes gratilla specimen photographed *in situ*.

Tripneustes gratilla, also known as the collector urchin, is a short-spined, black urchin. Its spines radiate in five double rows from the center of the test. Almost all spines are white, but some may be black. It often collects bits of algae and shell on its spines.

3.15.2.2 Family Echinometridae

***Echinostrephus aciculatus* A. Agassiz, 1863**



Echinostrephus aciculatus specimen photographed *in situ*.

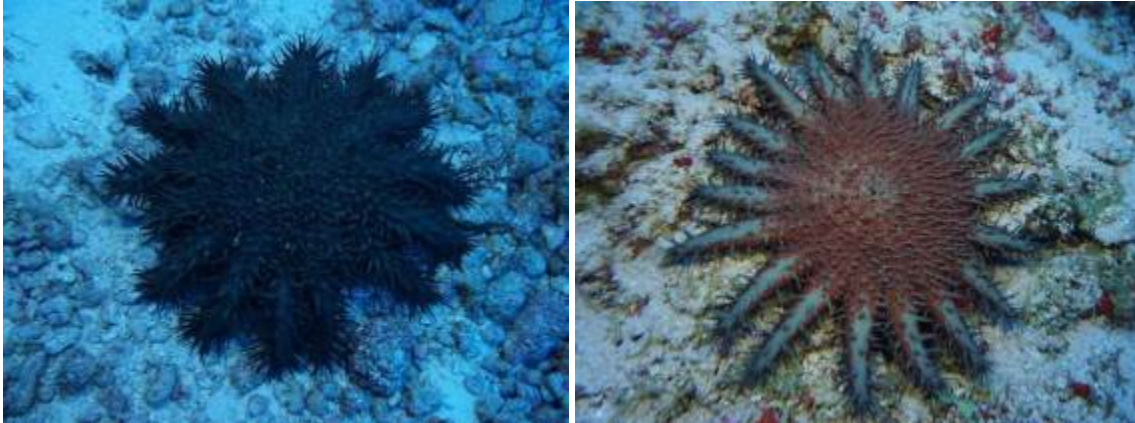
Echinostrephus aciculatus have black, lavender or brown spines that attach to a light colored test. This urchin is found in holes or other cavities in the substrate.

3.16 Sea Stars

3.16.1 Order Valvatida

3.16.1.1 Family Acanthasteridae

***Acanthaster planci* (Linnaeus, 1758)**



Acanthaster planci specimens photographed *in situ*.

Acanthaster planci, commonly known as the Crown-of-thorns sea star, is up to 45 cm in diameter and has 12-19 arms covered with stout sharp spines. It is usually brownish red, but can also appear greenish when alive.

3.16.1.2 Family Asterodiscididae
***Asterodiscides soleae* Rowe, 1985**



Asterodiscides soleae specimens photographed *in situ*.

Asterodiscides soleae has five thick arms that give rise to marginal plates on the tip of each arm. This sea star is maroon to red in coloration with pinkish marginal plates.

***Asterodiscides japonicus* Imaoka, Irimura, Okutani, Oguro, Oji & Kanazawa, 1991**

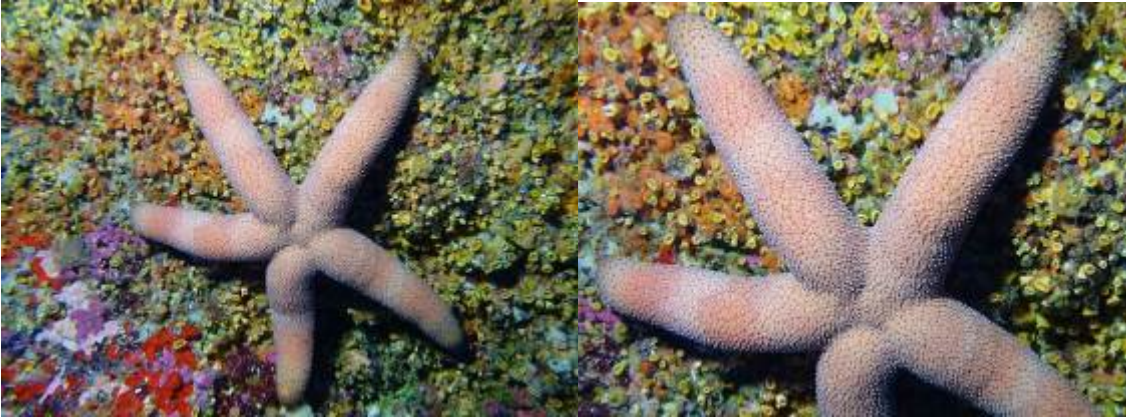


Asterodiscides japonicus specimen photographed *in situ*.

Asterodiscides japonicus has five short arms that protrude from the thick main body. This sea star is covered by numerous yellowish spines, with the rest of the body being either red or brown in coloration.

3.16.1.3 Family Mithrodiidae

Thromidia catalai Pope & Rowe, 1977



Thromidia catalai specimen photographed *in situ*.

Thromidia catalai is pinkish to light brown in coloration. The surface of this sea star is firm and covered with numerous hard nodules.

3.16.1.4 Family Ophidiasteridae

Linckia guildingi Gray, 1840



Linckia guildingi specimen photographed *in situ*.

Linckia guildingi usually has 5 long arms that appear smooth, but are hard and granular. The arms narrow where they attach to the central disk. It is usually dark grayish, green, brown or blue in coloration, but can also be reddish or beige.

***Linckia* sp.**



Unidentified *Linckia* specimen photographed *in situ*.

This *Linckia* sp. species has five long arms and is very dark in coloration.

***Leiaster leachi* (Gray, 1840)**



Leiaster leachi specimen photographed *in situ*.

Leiaster leachi, commonly known as the purple velvet star, is a large, reddish purple sea star that may also appear blue in deep water. It has a smooth, velvety texture.

3.16.1.5 Family Oreasteridae

***Pentaceraster cumingi* (Gray, 1840)**



Pentaceraster cumingi specimen photographed *in situ*.

Pentaceraster cumingi has five stiff arms that protrude from a massive central disk. Sea stars are red or maroon in coloration and covered with small, orange knobs over their entire surface.

3.17 Sea Cucumbers

3.17.1 Order Aspidochirotida

3.17.1.1 Family Holothuriidae

***Holothuria (Stauropora) cf. dofleinii* Augustin, 1908**



Holothuria cf. dofleinii specimen photographed *in situ*.

This sea cucumber has dark brown papillae and can attain sizes of up to 30 cm.

3.18 Mollusc Shells

3.18.1 Order Littorinimorpha

3.18.1.1 Family Cypraeidae

Cribrarula gaskoini Reeve, 1846



Cribrarula gaskoini specimen photographed *in situ*.

Cribrarula gaskoini shells are orange or orange-brown with numerous circular pale spots of varying color. There are dark spots in the band of white at the base of the shell. The mantle and foot of the animal are bright red.

3.18.1.2 Family Ranellidae

Charonia tritonis (Linnaeus, 1758)



Charonia tritonis specimen photographed *in situ*.

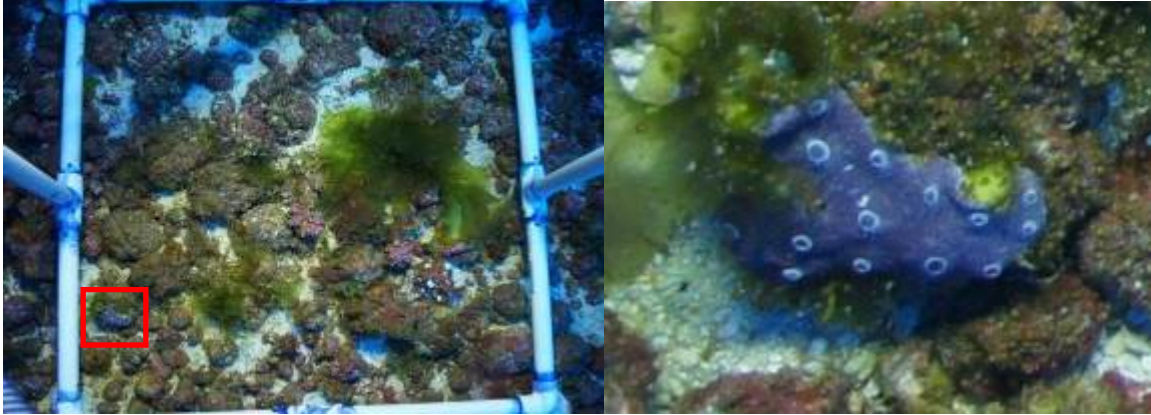
Charonia tritonis, commonly known as Triton's trumpet, has relatively smooth shells with spiral ribs. It is often obscured by coralline algae. The large aperture is reddish orange, and the inner edge has brown and white stripes.

3.19 Tunicates

3.19.1 Order Aplousobranchia

3.19.1.1 Family Didemnidae

Didemnum cf. *edmondsoni* Eldredge, 1966

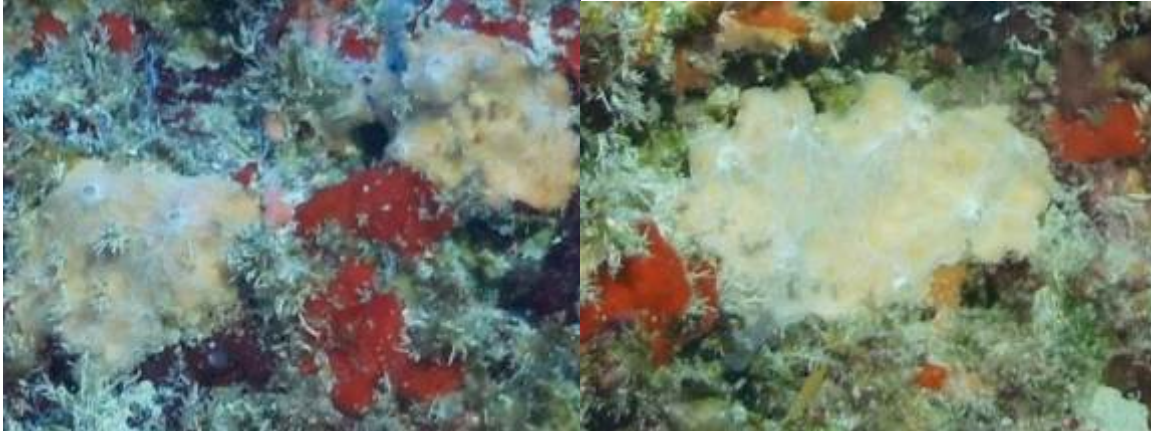


Didemnum edmondsoni specimen photographed *in situ*.

Didemnum cf. *edmondsoni* is an encrusting tunicate with oral siphons puncturing its surface. Its tissues are purple in coloration with white spots.

3.19.2 Unidentified Tunicate

Unidentified tunicate



Unidentified tunicate specimen photographed *in situ*.

This unidentified tunicate is tan to beige in coloration and frequently seen in shaded portions of the reef, such as underneath overhangs, in crevices or on steep vertical walls.

Chapter 4

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