EPIPHYTES OF THE SEA GRASS, *THALASSIA TESTUDINUM*, IN FLORIDA[1]

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ABSTRACT

One hundred and thirteen species of algae are reported occurring as epiphytes on the seagrass, *Thalassia testudinum*, 92 of which have been recorded from the south Florida area, 20 to 25 per cent of the total algal flora. Two groups of epiphytes are recognized, the year-around species and the seasonal annuals. Among the former are calcareous Corallinaceae which contribute significantly to the sediments of sea grass beds; among the latter is a group of large plants which may become sufficiently abundant during winter and spring to shade the *Thalassia* significantly. Each species listed is annotated, and a key to the species known to occur as epiphytes on *Thalassia* in south Florida is provided. *Stictyosiphon subsimplex* and *Polysiphonia harveyi* are newly reported for Florida; *Griffithsia barbata* is newly reported for the Bahamas.

INTRODUCTION

Thalassia testudinum König (turtle grass) is probably the most important plant species in the shallow marine waters of the Florida keys, around the entire Gulf of Mexico, and in the inshore waters of the islands and shoals of the West Indies and Caribbean Sea. Its greatest abundance along the Florida coast is in the Gulf of Mexico from Cedar Keys to Pensacola where the great width of the continental shelf provides a remarkably broad band of suitable habitat (Moore, 1963; Humm, 1956). It is highly productive as shown by Odum (1957) who recorded an evolution of 34 grams of oxygen per square meter of *Thalassia* bed per day at Long Key in the Florida Keys. On the basis of 3.4 calories production per gram of oxygen released, this would be 115.6 calories per square meter per day for *Thalassia* and its associates. The importance and magnitude of *Thalassia* as a bottom cover was indicated by Phillips (1960) who found a standing crop of 2,897 pounds per acre of dry weight of leaves only in Boca Ciega Bay south of St. Petersburg, Florida. The rhizomes and roots within the bottom sediments would more than double this figure, as Pomeroy (1960) found that the underground parts of the plants made up about 60 per cent of its dry weight. The water content of the leaves is about 85 per cent (Phillips, 1960). The major portion of the dry weight of the plant is cellulose.

The importance of *Thalassia* as a basic producer and as a habitat for a host of invertebrate animals has been emphasized by Voss & Voss

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(1955). Not only does this plant serve as a shelter from rigors of the physical environment and a refuge from predators for many marine animals, but it is also a source of food, either directly or indirectly. Ginsburg & Lowenstam (1958) have shown its important influence on marine sedimentation in shallow water.

Thalassia leaves serve as a suitable, sometimes ideal substratum for the attachment and growth of a wide variety of algae, invertebrates, and various microscopic organisms. These in turn must exert an important influence on the growth rate of *Thalassia* because of their competition for light and probably for nutrient salts, especially in areas of low current velocity. In Biscayne Bay and other marine waters of the Miami area and the Florida Keys, *Thalassia* leaves support a dense and varied crop of microscopic and macroscopic algae as epiphytes. The older the leaves the heavier the epiphytism until they decay and break loose from the plant.

Since no studies of the epiphytes of *Thalassia* have been made in this area, collections of material and determinations of species were made during the winter and spring of 1961-62. In addition to the records for the Miami area obtained at that time, data on epiphytes of *Thalassia* from the writer's notes for other areas are also included in the following annotated list, especially if there is no south Florida record.

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Annotated List of Thalassia Epiphytes

CYANOPHYTA

Order Coccogonales

Family Chamaesiphonaceae

Entophysalis conferta Drouet and Daily

This species always grows as an epiphyte on plants or animals in marine or brackish water, and it occurs as scattered groups of microscopic cells or as extensive cushion-like stratum. It is much less common on *Thalassia* than might be expected in view of its abundance on macroscopic algae in the same habitats. It is to be expected on *Thalassia* wherever the latter occurs, however. Apparently it does not penetrate the leaves of *Thalassia* (as it does on living algal hosts) until after the leaves are dead and somewhat softened. This is probably because of the firm surface layer of *Thalassia* leaves in contrast to the gelatinous polysaccharide outer layer of its algal hosts.

Entophysalis deusta Drouet and Daily

Since *E. deusta* is known to occur only on shells, rocks (principally limestone) and wood, it probably does not grow directly attached to *Thalassia*. It has been found repeatedly, however, penetrating the calcareous test of bryozoans coating the leaves, and in the tube of *Eupomatus*, an annelid of frequent occurrence on older leaves, and in other calcareous encrustations to which it lends a greenish tinge. Common throughout the range of *Thalassia*.

Order HORMOGONALES

Family Oscillatoriaceae

Oscillatoria corallinae Gomont

Forming typically a loose, brownish patch upon individual leaves or a skein that is continuous over several leaves of *Thalassia* in quiet shallow water. This growth form has been observed along mangroves on the Biscayne Bay side of Biscayne Key, Miami, and in Aransas Bay, Texas.

Hydrocoleum lyngbyaceum Gomont

In the form of very small, soft, light green tufts about 2 mm high on old leaves of *Thalassia* in protected areas such as Biscayne Bay just NW of the Seaquarium, Miami.

Symploca laete-viridis Gomont

Small patches or low tufts to 1 mm high of this species were found on *Thalassia* leaves along the protected outer beach of South Bimini, Bahamas, in November 1948. While not recorded on the same host in the Miami area, it surely occurs there.

Lyngbya sordida Gomont

L. sordida is one of the larger filamentous strictly marine bluegreens and is more or less limited to tropical waters. It was occasional on leaves of *Thalassia* and *Syringodium filiforme* Kützing *(Cymodocea manatorum* Ascherson) along the laboratory beach in Bear Cut, Miami.

Spirulina subsalsa Gomont

Occasional on *Thalassia* leaves forming a brilliant green or blue-green patch of actively waving spiral filaments 1.0-1.5 microns in diameter. Usually limited to protected areas but probably as widely distributed as *Thalassia* itself.

Arthrospira miniata Gomont

In the form of very soft, fragile brownish streamers on *Thalassia* leaves and other objects in shallow water but in rather exposed places. Only recently reported for Florida (Humm, 1963) and apparently Biscayne Bay is the only locality known in southeastern North America.

Schizothrix calcicola (C. Agardh) Gomont

Until the results of Drouet's extensive studies on the influence of the environment upon the major generic and specific characters used with the bluegreen algae were published, this material would have been associated with *Phormidium crosbyanum* Tilden. Drouet (1963), in working out the ecophenes of *Schizothrix calcicola,* discovered that *P. crosbyanum* is simply a growth form of *S. calcicola* that develops under certain conditions of relatively high salinity, clear and warm sea water. Under these circumstances the species produces firm, gelatinous spheres or hemispheres of a polysaccharide in which the filaments are embedded. This growth form is common in Biscayne Bay on leaves of *Thalassia,* on other algae, and on stones and shells (Bear Cut, Soldier Key); it is also common among the Florida Keys. It was originally described from Hawaii but has since been recorded from many stations in the West Indies and is probably widely distributed in tropical waters.

The *"Phormidium crosbyanum"* form of this plant was reported for Florida only last year (Humm, 1963), and is the only form recorded so far as an epiphyte of *Thalassia.*

Family Rivulariaceae

Calothrix crustacea Borner and Flahault

Producing scattered small tufts or groups of filaments 1-2 mm tall or less on *Thalassia* leaves. Common in Biscayne Bay and probably to be found wherever the host plant grows, although *C. crustacea* is much more common on other substrata.

RHODOPHYTA

Order BANGIALES

Family Bangiaceae

Asterocystis ramosa (Thwaites) Gobi

Plants forming soft, gray-green tufts to a few mm tall on *Thalassia* and various algae in shallow water. Fairly common in Biscayne Bay and probably present throughout the range of *Thalassia.* This green or lead-colored primitive red alga was long regarded as a bluegreen and is listed by Tilden (1910) under "genera not well understood," as is true also of *Goniotrichum alsidii.*

Goniotrichum alsidii (Zanardini) Howe

Although not recorded as growing directly upon *Thalassia,* this species was found many times as an epiphyte on larger algae attached to *Thalassia* leaves, as on *Spyridia filamentosa* from along the laboratory beach of Bear Cut in November 1961. It probably occurs on *Thalassia* also. Apparently it had not been reported for Florida until last year (Humm, 1963) although it has been collected repeatedly over a period of years.

Erythrocladia subintegra Rosenvinge

This species forms microscopic red disks to about 50 microns in diameter on the surface of *Thalassia* leaves and various algae.

Erythrotrichia carnea (Dillwyn) J. Agardh

Although the individual, unbranched filaments of this plant are virtually microscopic (15-25 microns in diameter), it sometimes grows in such abundance on *Thalassia* leaves as to form a distinct red fuzz. It is very common in Biscayne Bay and probably occurs throughout the range of the host. It is recorded as far north as North Carolina on various algae and on *Zostera marina*.

Order NEMALIONALES

Family Achrochaetiaceae

Kylinia crassipes (Børgesen) Kylin

One of the most common of the microscopic or nearly microscopic epiphytes of *Thalassia* in Biscayne Bay. It seems to be more abundant along the margins of the leaves than on the upper or lower surface.

Kylinia infestans (Howe and Hoyt) Papenfuss

Occasional within sertularian hydroids growing upon *Thalassia* leaves in Biscayne Bay. While the species is microscopic, it can be detected without magnification by the reddish tinge it imparts to the hydroids. It is known in hydroids only and was newly reported for Florida last year (Humm, 1963) having previously been recorded only from North Carolina (the type locality) and Bermuda.

Achrochaetium sagraeanum (Montagne) Bornet

Although not yet recorded for Florida, this species was reported as an epiphyte on *Thalassia* from Vera Cruz, Mexico (Humm & Hildebrand, 1962), and is to be expected in the south Florida area.

Achrochaetium seriatum Børgesen

Found on leaves of *Thalassia* and on algae in Mississippi Sound (Humm & Caylor, 1957) and on *Diplanthera wrightii* Ascherson in Aransas Bay, Texas (Humm & Hildebrand, 1962), and to be expected in the south Florida area.

Order CRYPTONEMIALES

Family Corallinaceae

Melobesia membranacea (Esper) Lamouroux

One of the most characteristic and abundant epiphytes on *Thalassia* leaves in the West Indies, Caribbean region. Plants forming flat, calcareous disks, pinkish when living, white when dead, and often covering old *Thalassia* leaves completely or nearly so (Fig. 1). This plant is

probably an important environmental factor for *Thalassia,* resulting in the early loss of effective leaf surface where epiphytism is severe. *Melobesia* probably contributes calcareous sediments to *Thalassia* flats to a very significant extent. Its growth rate and importance should be studied. The species occurs on *Thalassia* in the northern Gulf of Mexico around the Chandeleur Islands (Humm & Darnell, 1959).

Fosliella farinosa (Lamouroux) Howe

This species shares with the above the distinction of being one of the most common epiphytes on *Thalassia* leaves. The two are very similar, but *F. farinosa* can be distinguished by the colorless swollen cells ("trichocytes") which terminate each cell row. Comments above apply also to this species. Both are abundant in Biscayne Bay, Miami, and apparently occur on *Thalassia* throughout its range. The variety *solmsiana* (Falkenberg) Taylor, consisting of meandering filaments united at points of contact, also occurs on *Thalassia.*

Fosliella lejolisii (Rosanoff) Howe

Lemoine (*in* Børgesen, 1917), a recognized authority on the Corallinaceae, doubts that this species occurs in tropical waters and suggests that specimens from Florida and the West Indies associated with it are *F. farinosa* in which the trichocytes are poorly developed or lacking. Since this species has been reported repeatedly in the tropical Atlantic and since no study has been made to verify or invalidate Mme. Lemoine's contention, it is listed here as a third species of calcareous disk-forming epiphyte on *Thalassia.* Specimens lacking apparent trichocytes and with only one pore in the tetrasporangial conceptacle are common on *Thalassia* in Biscayne Bay, Miami.

Jania adhaerens Lamouroux

Although not recorded from the Miami area on *Thalassia,* this species was collected in Bimini Bay, Bahamas, on *Thalassia* in 1948.

Jania capillacea Harvey

On *Thalassia* from Biscayne Bay at Matheson Hammock, though not common on this host.

Lithophyllum pustulatum (Lamouroux) Foslie

Found once on *Thalassia,* forming a thick crust at the base of an old leaf at the mouth of Bear Cut, Miami.

Order GIGARTINALES

Family Gracilariaceae

Gracilaria foliifera (Forsskal) Børgesen

Although not generally an epiphyte of *Thalassia,* small plants may occasionally be found on the leaves in protected areas.

Family Solieriaceae

Agardhiella tenera (J. Agardh) Schmitz

Like *Gracilaria,* this species is not a common epiphyte on *Thalassia* but it has been found as such near Snapper Creek, Biscayne Bay, Miami, and it is more frequent on this host in Tampa Bay, especially during winter and spring.

Family Hypneaceae

Hypnea musciformis (Wulfen) Lamouroux

Hypnea occurs occasionally as small plants on *Thalassia* in Biscayne Bay, but young *Hypnea* plants on *Thalassia* in lower Tampa Bay are abundant in the fall and winter. As these plants grow, they break loose from the *Thalassia* where tidal currents and wave action are generally too weak to move them. In the absence of the *Thalassia* beds and other sea grasses in lower Tampa Bay, it is doubtful if *Hypnea* would become so abundant each winter and spring as there would be much less suitable substratum for spore germination and survival of germlings.

Order RHODOMENIALES

Family Champiaceae

Champia parvula (C. Agardh) Harvey

Thalassia is perhaps the most common substrate for *Champia parvula* in Biscayne Bay, although the species is not extremely abundant and the plants are typically smaller than those of the middle Atlantic states and farther north.

Lomentaria baileyana (Harvey) Farlow

This species forms soft, much-branched plants that are often attached to the margin of a *Thalassia* leaf. They seem to be more common during winter months in the Miami area. In North Carolina it is a spring species and in the northern part of its range, from New Jersey to northern Massachusetts, it is a summer species.

Order CERAMIALES

Family Ceramiaceae

Crouania attenuata (Bonnemaison) J. Agardh

Thalassia leaves are a common place of attachment for this species, especially along the wading beach at Matheson Hammock, south Biscayne Bay, Miami (Fig. 2).

Crouania pleonospora Taylor

This species is characteristic of areas of high and stable salinity and clear water and is more common among the keys than in the Miami area. It is of frequent occurrence on *Thalassia.*

Wrangelia argus Montagne

Not a usual epiphyte of *Thalassia* but collected as such at the south end of South Bimini, Bahamas, April 1948.

Wrangelia penicillata C. Agardh

Thalassia leaves often support this species, especially in Biscayne Bay along Cocoplum Beach and Matheson Hammock. It was also collected as a *Thalassia* epiphyte in the inlet to Bimini Harbor in April 1948.

Callithamnion cordatum Børgesen

Found on *Thalassia* in Bear Cut in November, 1961. The cystocarps are distinctly trilobed and cordate. Known previously from the Virgin Islands (the type locality), Bermuda, and the Florida Gulf coast, with some doubt (Phillips & Springer, 1960).

Callithamnion halliae Collins

Probably the most common *Callithamnion* in Biscayne Bay, Miami, and frequently growing attached to *Thalassia.*

Griffithsia barbata (Smith) C. Agardh

This report constitutes a new locality for this species which was found on Thalassia in the inlet to Bimini Harbor in April 1948. It was previously known only from the Virgin Islands in the West Indian region but it may be expected in Florida. The tetrasporangia are borne individually on the upper end of the basal cell of a trichoblast.

Griffithsia globulifera Harvey

On *Thalassia* from the extensive flats off Southwest Point, Key Biscayne, December 1961.

Griffithsia tenuis C. Agardh

At the same time and place as the above species. This seems to be the most common species of *Griffithsia* along the mainland where it reaches North Carolina. It is also in the Bermuda flora.

Spermothamnion gymnocarpum Howe

On *Thalassia* in Bimini Bay, Bahamas, March 1948. This species is still known only from the Bahamas, the type area (Howe, 1920).

Ceramium byssoideum Harvey

One of the most abundant of the non-calcareous algal epiphytes on *Thalassia,* especially in Biscayne Bay, Miami.

Ceramium fastigiatum (Roth) Harvey

Common on *Thalassia* in Biscayne Bay as forma *flaccida* Petersen.

Ceramium nitens (C. Agardh) J. Agardh

Often found growing on *Thalassia* leaves in Biscayne Bay, Miami;

collected on this host around Isla Perez, Alacran Reef, Campeche Banks, southern Gulf of Mexico, June 1961. There is a specimen on *Thalassia* in the algal herbarium of Duke University collected at Bermuda in 1861 by Miss Emma Lehman and determined by Dr. Marshall A. Howe.

Ceramium subtile J. Agardh

Producing a heavy growth around *Thalassia* leaves, Los Hornos reef, Vera Cruz, Mexico, in April 1956; collected by Dr. Henry Hildebrand.

Centroceras clavulatum (C. Agardh) Montagne

A common epiphyte on *Thalassia* though this is by no means a substratum that favors its full development.

Spyridia aculeata (Schimper) Kützing

This species occurs on *Thalassia* leaves in less protected waters than the one that follows and in less abundance.

Spyridia filamentosa (Wulfen) Harvey

Thalassia leaves are a common place of attachment for young plants of this species in Biscayne Bay. Along the Florida Gulf coast from Tampa Bay to Alligator Harbor, *Thalassia* beds in protected areas may develop quantities of this species during winter and spring. Like *Hypnea* the plants tend to break loose from the leaves as they grow large and then continue to grow among the sea grass plants until dislodged or until they deteriorate in late spring or early summer.

Family Delesseriaceae

Hypoglossum involvens (Harvey) J. Agardh

Thalassia leaves are the only substratum from which this plant has been collected by the writer. Its presence in Biscayne Bay seems to be erratic and localized. In January of 1946, it was very abundant along Cocoplum Beach and Matheson Hammock. It was sought but not found during the winter and spring of 1961-62. It is not a deep-water plant as postulated by Taylor (1960) but apparently one characteristic of *Thalassia* beds.

Hypoglossum tenuifolium (Harvey) J. Agardh

Although found growing on a variety of substrata, *Thalassia* leaves were a common one for this plant in Biscayne Bay, Miami, where it was quite abundant from November to February, 1961-62. It grows in both deep and shallow water.

Family Dasyaceae

Dasya collinsiana Howe

Common on *Thalassia,* large algae and stones in shallow water, especially along the south side of Bear Cut during the winter and spring of 1961-62.

Dasya corymbifera J. Agardh

Occasional on *Thalassia* and *Diplanthera* along the beach near the laboratory, Virginia Key side of Bear Cut, Miami, January 1962.

Dasya pedicellata (C. Agardh) C. Agardh

Though usually attached to stones or shells, this species occasionally grows on a *Thalassia* leaf from which it breaks loose before maturity. In the southern part of its extensive range, it is a winter and spring species.

Dasya rigidula (Kützing) Ardissone

One specimen was collected growing attached to *Thalassia* along the ocean beach of Biscayne Bay between Bear Cut and Crandon Park, Miami, March 1961.

Dasya harveyi Ashmead

Found on *Thalassia* in Bimini Bay, Bahamas, in March 1948, where it was quite common at that time.

Heterosiphonia gibbesii (Harvey) Falkenberg

Occasional on *Thalassia* in Biscayne Bay near Matheson Hammock, but much more common on rocks or *Halimeda*.

Heterosiphonia wurdemanni (Bailey *ex* Harvey) Falkenberg

Occasional on old leaves of *Thalassia*, especially those with a layer of calcareous encrusting algae or bryozoa, Biscayne Bay, Miami.

Family Rhodomelaceae

Falkenbergia hillebrandii (Bornet) Falkenberg

Occasional on leaves of *Thalassia* in Biscayne Bay, but more common among the Florida keys. The cells of this plant are characterized by a large, conspicuous nucleus 13-14 microns in diameter, spherical and centrally located. Branching wide-angled and dense with only 4 or 5 segments between the branches.

Polysiphonia binneyi Harvey

Common on *Thalassia* leaves in Biscayne Bay and at Bimini, Bahamas.

Polysiphonia denudata (Dillwyn) Kützing

Recorded from *Thalassia* leaves around the Chandeleur Islands off the mouth of the Mississippi River (Humm & Darnell, 1959).

Polysiphonia echinata Harvey

Probably the most common *Polysiphonia* on *Thalassia* along the Florida Gulf coast from Tampa Bay to Pensacola.

Polysiphonia gorgoniae Harvey

The most common polysiphonia on *Thalassia* in Biscayne Bay. The

plants are about one-half to one inch tall with an erect and single main axis, dichotomous branching, and with a dense tree-like top.

Polysiphonia haplacantha Harvey

Recorded on *Thalassia* from Harbor Island near the causeway, Nueces County, Texas, June 1952, collected by Charlene and Kirk Strawn. Probably common on *Thalassia* in the Gulf of Mexico.

Polysiphonia harveyi Bailey

This northern species of *Polysiphonia* apparently does not occur around southern Florida, but grows on *Thalassia* along the northern Florida Gulf coast. It seems to appear each November and disappear in March or April in the area of Alligator Harbor, and it agrees most closely with *P. harveyi* as found along the coast of North Carolina and Virginia. If reference to this species is correct, then this constitutes a new report for Florida.

Polysiphonia havanensis Montagne

This very slender and delicate *Polysiphonia* is a frequent inhabitant of *Thalassia* leaves in Biscayne Bay and elsewhere around the Florida coast.

Polysiphonia ramentacea Harvey

Occasional on *Thalassia* in Biscayne Bay and also along the Florida Gulf coast and at Bimini, Bahamas.

Polysiphonia subtilissima Montagne

Occasional on *Thalassia* leaves in Aransas Bay, Texas, and in other areas where *Thalassia* grows in the lower part of its salinity range. This species of *Polysiphonia* tolerates lower salinity than most species of this region.

Digenia simplex (Wulfen) C. Agardh

One of the most common of the larger algae in *Thalassia* beds where it may be attached to stones or shells or lying loose. Occasionally it develops on *Thalassia* leaves.

Wrightiella tumanowiczii (Gatty) Schmitz

On *Thalassia,* large algae, and stones along the Florida keys but especially along the southwest side of Pigeon Key beneath Seven Mile Bridge.

Herposiphonia pecten-veneris (Harvey) Falkenberg

Leaves of *Thalassia* are a principal place of attachment for this species and it is often one of the principal epiphytes in Biscayne Bay and the Florida Keys, especially Largo Sound, Key Largo.

Herposiphonia secunda (C. Agardh) Ambronn

Often very common on the older leaves of *Thalassia* and probably present on the host plant throughout its range.

Lophosiphonia sacchoriza Collins and Hervey

Found on *Thalassia* in St. Andrews Bay, Panama City, Florida, and from along South Shoals off Alligator Harbor, Franklin County. This material is associated with this species with some doubt. Dr. G. J. Hollenberg has examined a portion of the material from St. Andrews Bay and points out that the branches do not seem to arise endogenously and that for this reason and others, it may be an undescribed species of *Polysiphonia*. A greater quantity of material of this relatively rare plant is needed for an adequate study of it.

Acanthophora spicifera (Vahl) Børgesen

This relatively large and abundant species normally grows attached to stones, but is sometimes epiphytic on *Thalassia, Halimeda* or *Digenia* in Biscayne Bay and among the Florida Keys.

Chondria baileyana (Montagne) Harvey

This is a winter and spring species in the southern part of its extensive range along the Atlantic coast of the United States and it occasionally appears on *Thalassia* leaves along the entire Gulf coast of Florida and less commonly in Biscayne Bay. It is one of the most slender of the larger species of *Chondria*.

Chondria cnicophylla (Melvill) De Toni

This species of *Chondria* is abundant along the Florida coast from Tampa Bay northward but especially from Cedar Keys northward. Apparently it has not been recorded from the Miami area or the Florida keys nor from the Atlantic coast of North America. The plants very commonly originate on *Thalassia* leaves and later break loose and continue to grow among *Thalassia* in the sheltered areas to which it is best adapted.

Chondria collinsiana Howe

This small *Chondria* is found on *Thalassia* leaves about as commonly as on any other substratum in the Miami area, and its presence on *Thalassia* was noted in the original description (Howe, 1920). It has been collected on *Thalassia* also in St. Andrews Bay, Panama City.

Chondria curvilineata Collins and Hervey

Although found in greater abundance on *Syringodium,* this species was also present on *Thalassia* in Bear Cut, Miami, in November 1961, and was quite abundant.

Chondria dasyphylla (Woodward) C. Agardh

This is one of the larger species of *Chondria* and normally grows attached to rocks. Occasionally plants become established on *Thalassia* as at Southwest Point, Biscayne Key, Miami, in December 1962.

Chondria polyrhiza Collins and Hervey

This species is characterized by the formation of a cluster of rhizoids from branches that touch the substratum and is thus adapted to growth on *Thalassia* leaves on which it is often found in Biscayne Bay, Miami, and among the Florida keys, especially in Largo Sound, Key Largo.

Laurencia obtusa (Hudson) Lamouroux

Normally attached to rocks or mangrove roots, this species occasionally grows on *Thalassia*. It has been found thus in Biscayne Bay near Matheson Hammock, in Largo Sound, Key Largo, and in Bimini Bay, Bahamas.

Laurencia poitei (Lamouroux) Howe

This species is often one of the most common of the larger algae in *Thalassia* beds, although the plants are usually attached to stones. Occasionally, *L. poitei* grows upon the leaves.

PHAEOPHYTA

Order ECTOCARPALES

Family Ectocarpaceae

Ectocarpus confervoides (Roth) Le Jolis

This northern species appears each winter in northern Florida and is abundant on *Thalassia* in Alligator Harbor, south of Tallahassee, and in St. Andrews Bay, Panama City, from November or December until March or April.

Ectocarpus elachistaeformis Heydrich

Occasional on *Thalassia* as minute tufts in Biscayne Bay at Miami and among the Florida keys.

Ectocarpus siliculosus (Dillwyn) Lyngbye

Abundant on *Thalassia* in the vicinity of Alligator Harbor, northern Florida Gulf coast and westward to Galveston, Texas, annually during winter and early spring.

Ectocarpus variabilis Vickers

Thalassia leaves are apparently a common habitat for this minute species (1-2 mm high), as it has been thus collected in Bear Cut, Miami (Humm, 1963) and at Punta Hornos reef, Vera Cruz, Mexico (Humm & Hildebrand, 1962).

Giffordia conifera (Børgesen) Taylor

On *Thalassia* at Pass-a-Grille, Florida, near St. Petersburg, March 1956, collected by Joanna Woodson Parrish. This is an earlier collection than the one on which the original Florida report is based (Humm, 1963).

Giffordia duchassaigniana (Grunow) Taylor

Occurs occasionally on *Thalassia* in Biscayne Bay, apparently more common during winter and spring than at other times.

Giffordia mitchellae (Harvey) Hamel

Sea grass leaves are a common place of attachment for this widespread species. It has been found on *Thalassia* in Biscayne Bay, Miami, during the winter months, along the northern Gulf coast of Florida, in Mississippi Sound, and near Vera Cruz, Mexico. In the northern part of its range, from New Jersey to Southern Massachusetts, it is often found on eel grass, *Zostera marina.*

Giffordia rallsiae (Vickers) Taylor

On *Thalassia* in Bear Cut, Biscayne Bay, Miami, and among the Florida keys (Humm, 1963).

Acinetospora pusilla (Griffiths) Bornet

First reported for Florida from *Thalassia* at Pass-a-Grille near St. Petersburg, March 1955, collected by Joanna Woodson Parrish (Humm, 1963). The species has also been collected on intertidal rocks north of Miami at Boca Raton, but is not yet known for the Miami area. It is recorded on *Thalassia* also from near Vera Cruz, Mexico (Humm & Hildebrand, 1962), but the first record of the plant for North America was from North Carolina (Blomquist, 1955).

Family Dictyotaceae

Dictyota bartayresii Lamouroux

Occasional on *Thalassia,* although usually on stones and later forming loose masses on the bottom, especially among soft corals or coral reefs, Biscayne Bay, Miami, and at Curaçao.

Dictyota dichotoma (Hudson) Lamouroux

Of occasional occurrence on *Thalassia* leaves in shallow water. This species of *Dictyota* extends farthest north of any; known to the Eastern Shore of Virginia (Humm, 1963a).

Dictyota divaricata Lamouroux

This smallest West Indian *Dictyota* occasionally grows attached to the older leaves of *Thalassia.*

Padina sanctae-crucis Børgesen

Like *Dictyota dichotoma* this species is also occasionally encountered on *Thalassia* in Biscayne Bay, Miami, and has been collected on *Thalassia* in Puerto Rico by Dr. Luis Almodóvar and in Lameshur Bay, St. John, Virgin Islands, by the writer.

Order CHORDARIALES

Family Myrionemataceae

Ascocyclus orbicularis (J. Agardh) Magnus

Known from St. Andrews Bay, Panama City, Florida, on old *Thalassia* blades (Humm, 1963), and from Bermuda on algae and sea grasses (Collins & Hervey, 1917).

Family Chordariaceae

Eudesme zosterae (J. Agardh) Kylin

This species was named because it is found almost exclusively on the leaves of sea grasses. In the northern part of its range, from South Carolina to Nova Scotia and St. Pierre et Micquelon, it grows on *Zostera marina;* in Florida and along the northern Gulf of Mexico it grows on *Thalassia* or smaller sea grasses and is present only during winter and spring. In what form it is present during the remainder of the year is unknown, and it is puzzling that it should appear rather suddenly in the Miami area early in January on *Thalassia* leaves that did not exist when *Eudesme* plants were last present the previous spring.

E. zosterae, as its northern range suggests, is a northern species primarily. It is highly probable that many of the records were actually *Cladosiphon occidentalis,* which it resembles closely and which is a more temperate water species. It may be that *Eudesme* occurs in Florida only along the northern Gulf coast and north of Cape Kennedy during the cold months.

Cladosiphon occidentalis Kylin

Abundant on *Thalassia* and other sea grasses in Bear Cut, Miami, from early January until early April 1962. In some areas the shading of *Thalassia* by this plant must have had a considerable influence on the rate of photosynthesis by the host, as the *Thalassia* was almost covered during the peak of development of *Cladosiphon* (Fig. 3).

Order PUNCTARIALES

Family Striariaceae

Stictyosiphon subsimplex Holden

Abundant on *Diplanthera* and occasional on *Thalassia* during winter and spring, 1961-62, in Bear Cut and at many stations in Biscayne Bay, Miami. This is the first report for Florida. The species was known only from Connecticut and Massachusetts.

Family Punctariaceae

Myriotrichia subcorymbosa (Holden) Blomquist

This species seems to occur exclusively on sea grass leaves. In the southern part of its range (North Carolina to the West Indies) it grows

mainly on *Diplanthera wrightii* (Ascherson) Ascherson but occasionally on *Thalassia* forming little tufts 1-3 mm high and resembling a small *Ectocarpus*. Blomquist (1954, 1958) clearly indicated that it has all the essential characteristics of the genus *Myriotrichia* and it is therefore puzzling that Taylor (1960) retained it in the genus *Ectocarpus*. It occurs all around the coast of Florida and along the northern and western coasts of the Gulf of Mexico. Along the Atlantic coast it occurs from Florida to Massachusetts and grows on *Ruppia maritima* north of North Carolina.

Rosenvingia intricata (J. Agardh) Børgesen

Occasional on *Thalassia,* Biscayne Bay, Miami, and also along the Florida Gulf coast from Fort Myers to Tampa Bay, winter and spring.

CHLOROPHYTA

Order TETRASPORALES

Family Palmellaceae

Pseudotetraspora antillarum Howe

The original collection of this species (Howe, 1920) came from sea grasses in the Bahamas. It has since been collected from *Thalassia* and large algae off Wakulla and Dixie Counties, northern Gulf coast of Florida (Humm & Taylor, 1961), and washed ashore in North Carolina (Aziz & Humm, 1962).

Order ULOTRICHALES

Family Ulotrichaceae

Phaeophila dendroides (Crouan) Batters

Common on *Thalassia* in Biscayne Bay, Miami, and probably throughout the range of the host plant.

Family Ulvaceae

Enteromorpha chaetomorphoides Børgesen

This slender, attenuate plant seemed to appear in Biscayne Bay in November and became steadily more abundant until February. It was often found wrapped around leaves of *Thalassia,* algae, and mangrove roots but it apparently was not attached. It may have come in with pelagic *Sargassum*.

Enteromorpha clathrata (Roth) J. Agardh

The *"Enteromorpha crinita"* form of this plant was quite common on *Thalassia* leaves in quiet waters near mangroves, Biscayne Bay along Biscayne Key, Miami; also from Los Hornos reef, Vera Cruz, Mexico, December 1956 (Humm & Hildebrand, 1962).

Enteromorpha lingulata J. Agardh

One of the most common green algae on *Thalassia,* especially in the

spring, Biscayne Bay, and along the ocean beach of Virginia Key, Miami.

Enteromorpha plumosa Kützing

Small slender plants of this species were often encountered on *Thalassia* leaves, usually with the slender opposite branches and long uniseriate tips. Bear Cut, Miami, winter and spring.

Enteromorpha prolifera (Müller) J. Agardh

A common epiphyte of *Thalassia,* especially on the tips of the leaves. It became more abundant in the spring in protected areas in Biscayne Bay, Miami 1962.

Enteromorpha salina Kützing

Scattered plants were found attached to *Thalassia* leaves at Punta Hornos, Vera Cruz, Mexico, by Dr. H. H. Hildebrand in July 1957 (Humm & Hildebrand, 1962). The species was not seen at Miami during the winter and spring of 1961-62.

Ulva lactuca Linnaeus

Although rarely seen attached to sea grasses in the fall and winter, it became extremely abundant on *Thalassia* along the ocean beach of Virginia Key, Miami, in the spring of 1962 when it was the most abundant epiphyte in this area and must have shaded the host plants considerably.

Order CLADOPHORALES

Family Cladophoraceae

Chaetomorpha minima Collins and Hervey

This plant formed a fine, green fuzz on *Thalassia* and *Diplanthera* leaves along the marine laboratory beach, Bear Cut, Miami, early in 1962 (Humm, 1963). The Bahamas are the type locality (Collins & Hervey, 1917).

Rhizoclonium riparium (Roth) Harvey

Occasional on *Thalassia* in mangrove lagoons near Cocoplum Beach, Biscayne Bay, Miami, and at Los Hornos reef, Vera Cruz, Mexico.

Cladophora delicatula Montagne

Plants referred to this species from *Thalassia* leaves in Biscayne Bay, Miami, were mostly one-half to one inch tall, densely branched and of slender axes. Small plants of the genus are especially difficult to determine with confidence.

Cladophora fascicularis (Mertens) Kützing

This was the most common species of *Cladophora* on *Thalassia* leaves in the Miami area and the plants sometimes reached one foot in length. It is probably the most distinctive species of any *Cladophora* in the region.

Cladophora sericea (Hudson) Kützing

Until publication of the monograph on *Cladophora* by Van Den Hoek (1963), this material would have been referred to *C. glaucescens* (Griffiths *ex* Harvey) Harvey, which Van Den Hoek indicates is a synonym of *C. sericea*. It is occasional on *Thalassia* in Biscayne Bay, Miami.

Family Anadyomeniaceae

Anadyomene stellata (Wulfen) C. Agardh

This beautiful, leaf-like plant is characteristic of *Thalassia* beds where it usually grows attached to stones or to *Digenia simplex*. Occasionally, however, *Anadyomene* plants arise on the leaves of *Thalassia*. It is abundant in Biscayne Bay, Miami, and probably occurs throughout most of the range of *Thalassia*, except in the northern part. It occurs among *Thalassia* off Alligator Harbor, Franklin County, Florida (Humm & Taylor, 1961), and at Panama City, but it was not found in Mississippi Sound (Humm & Caylor, 1957) nor around the Chandeleur Islands (Humm & Darnell, 1959; Mullahy, 1959).

Discussion

Seasonal Variation.—The algal epiphytes of *Thalassia* in South Florida waters vary considerably with season both in abundance and in species composition. In general, the epiphytes are least in abundance and variety in early and mid-summer, just after the host plant has completed its most rapid period of growth. There is a gradual increase of epiphytes from late August until the period February 15-March 15, when the peak of both abundance and variety is reached. Growth of *Thalassia* apparently becomes slower in late summer possibly because of water temperatures that are above optimum (especially in shallow, inshore areas), and possibly also because of a more rapid use than manufacture of food reserves and photosynthate during the period of rapid growth. Thus production of new leaves is slower and epiphytes have had time to colonize the leaves of the spring growth.

Annual Epiphytes.—Two floras can be recognized on the basis of seasonal behavior: the majority group that tends to be present the year around, and the minority group that tends to appear late in the fall and to disappear in the spring. Among the latter group are a number of species that are particularly adapted to growing on leaves of sea grasses and which, during winter and spring, are in great abundance. If the winter-spring species were eliminated, leaf epiphytism would be more uniform, though there would still be a reduction just after the spring growth and an inconspicuous peak in late summer and fall. The most important species of the winter-spring annuals are *Cladosiphon occidentalis* (Fig. 3), *Ulva lactuca*,

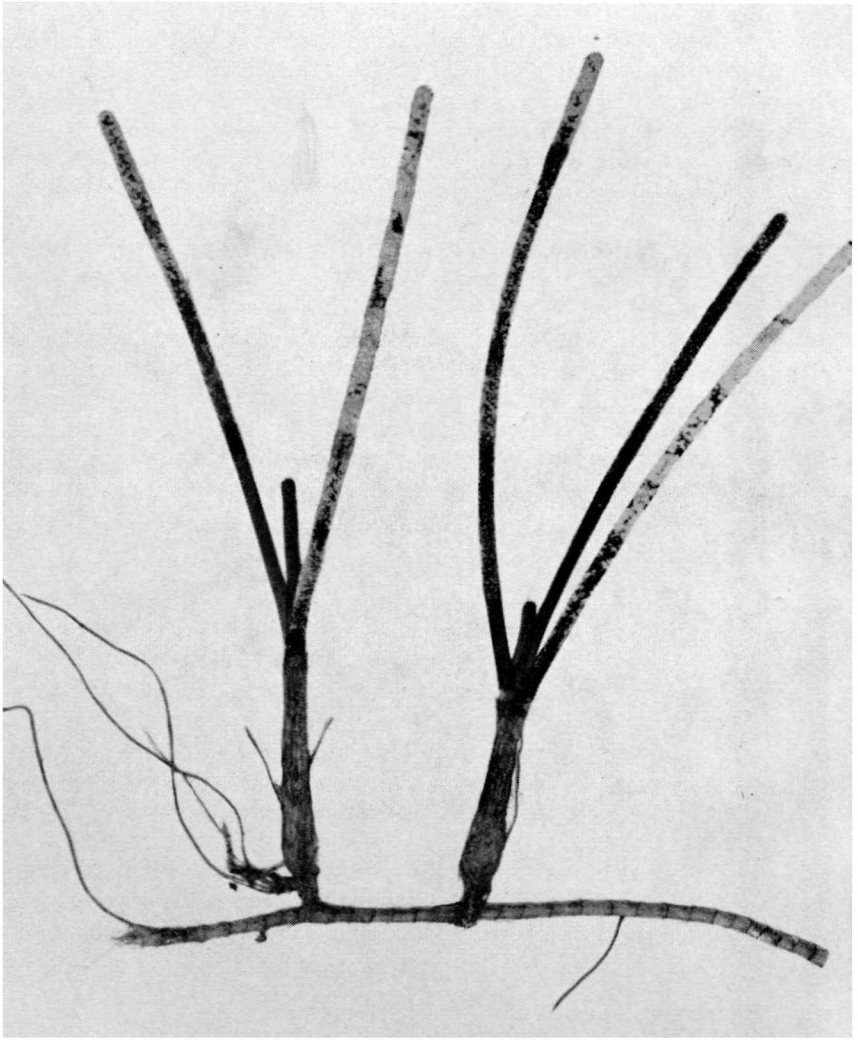

FIGURE. 1. *Thalassia testudinum* with a heavy encrustation of the coralline red alga *Melobesia* on the leaves. These epiphytes often appear on the leaves before they have reached their full length. Photograph by Ronald C. Phillips.

Ectocarpus confervoides (in some areas), *Ectocarpus mitchellae*, and several species of *Enteromorpha*. These are all large plants.

Year-around Epiphytes.—Among the year-around species there is one group of major importance as epiphytes, the small, calcareous encrusting

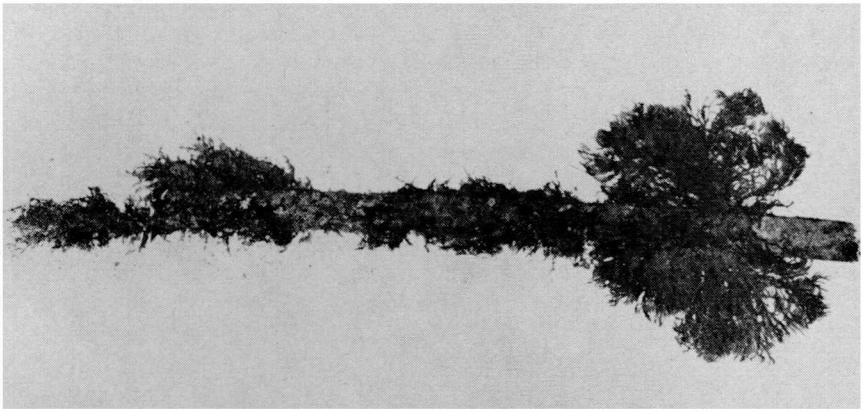

FIGURE 2. A leaf of *Thalassia* with a variety of algal epiphytes that are mostly year-around in occurrence. The large plant is *Crouania attenuata*. Among the others were the genera *Melobesia, Fosliella, Chondria, Polysiphonia, Ceramium, Kylinia, Herposiphonia, Cladophora, Giffordia* and *Calothrix* and a total of thirteen or more species.

forms of the Corallinaceae of which three species are recognized: *Melobesia membranacea, Fosliella farinosa,* and *Fosliella lejolisii*. These species, in the *Thalassia* habitats most favorable to them, will often form an almost complete coating of calcium carbonate over the older *Thalassia* leaves (Fig. 1). As a result, these leaves seem to die earlier than they would if not thus epiphytized and the weight of the calcium carbonate is such that they tend to sink rather than float as *Thalassia* leaves normally do. These small calcareous disks reduce the light intensity only for those leaves on which they are growing and not for the younger leaves on which they have not yet become established. The large plants of the principal winter-spring epiphytes, on the other hand, tend to shade the entire *Thalassia* plant as these algae are typically 15-30 cm long and are bushy and thus they reduce the efficiency of the younger leaves of the plant by shading about as much as they do for the leaves to which they are attached.

Effect on Sedimentation.—Ginsburg & Lowenstam (1958) pointed out two ways in which *Thalassia* beds modify marine sedimentation in the areas they occupy. In the first place, they have a strong tendency to stabilize sediments in the *Thalassia* bed by protection of the bottom from wave action and currents; in the second place, they tend to speed up sedimentation significantly from the water over the *Thalassia* beds through the creation of semimotionless water through which particles fall that would tend to remain in suspension if the water were not slowed down by the grass leaves. It appears to the writer that there is still a third contribution

of importance that *Thalassia* makes to the accumulation of sediments. Since the leaves of *Thalassia* serve as such an ideal substratum for the calcareous, encrusting Corallinaceae, the amount of additional calcium carbonate that these plants precipitate is ultimately contributed to the *Thalassia* bed, for the most part, as the *Thalassia* leaves die and decay. In fact, a considerable proportion of the old and dead *Melobesia* and *Fosliella* plants is sloughed off the *Thalassia* leaves before they decay or become detached from the stem. It is probably possible to recognize the *Melobesia-Fosliella* portion of recent sediments in *Thalassia* beds by microscopic examination. Research is needed on the growth rates of these calcareous epiphytes, the factors of the environment responsible for their best development, and their relative importance in the accumulation of sediments beneath *Thalassia* and other sea grasses.

Productivity.—Pomeroy (1960) found that *Thalassia,* phytoplankton, and the microflora in or on bottom sediments contribute about equally to the productivity of Boca Ciega Bay, south of St. Petersburg, Florida Gulf coast, wherever the water is less than two meters in depth. In deeper water, *Thalassia* does not do well in Boca Ciega Bay because of turbidity, and the phytoplankton then become the principal producers. Pomeroy also reported that there was no significant difference between the photosynthetic rate of *Thalassia* leaves stripped of "Aufwuchs" and of unmodified leaves, and apparently he did not consider the macroscopic algae of Boca Ciega Bay as contributing significantly to productivity. The writer finds this conclusion difficult to accept, at least in implication. There are times when the *Thalassia* in Boca Ciega Bay is abundantly epiphytized by macroscopic algae (personal observations) and it would appear that during these periods the photosynthesis of the epiphytes may rival or exceed that of the host. It may be that when *Thalassia* leaves are relatively free of epiphytes, the microscopic forms present (mainly diatoms) are of little significance in total productivity, but this situation should not be the basis for a general conclusion.

Sea Grasses as a Substratum.—Algal epiphytes of sea grasses can be divided roughly into three groups on the basis of the importance to the algae of sea grass leaves as a substratum. In the first group are those algae which are found exclusively, or nearly so, on sea grass leaves. Examples of these are *Eudesme zosterae, Cladosiphon occidentalis, Myriotrichia subcorymbosa,* and *Stictyosiphon subsimplex* of the brown algae; *Melobesia membranacea, Fosliella farinosa,* and *Fosliella lejolisii* of the coralline red algae. The three species of browns listed above are almost exclusively sea grass epiphytes and the first two are strictly seasonal. *Myriotrichia* has not been reported on any other type of host or substrate, but it is apparently year-around.

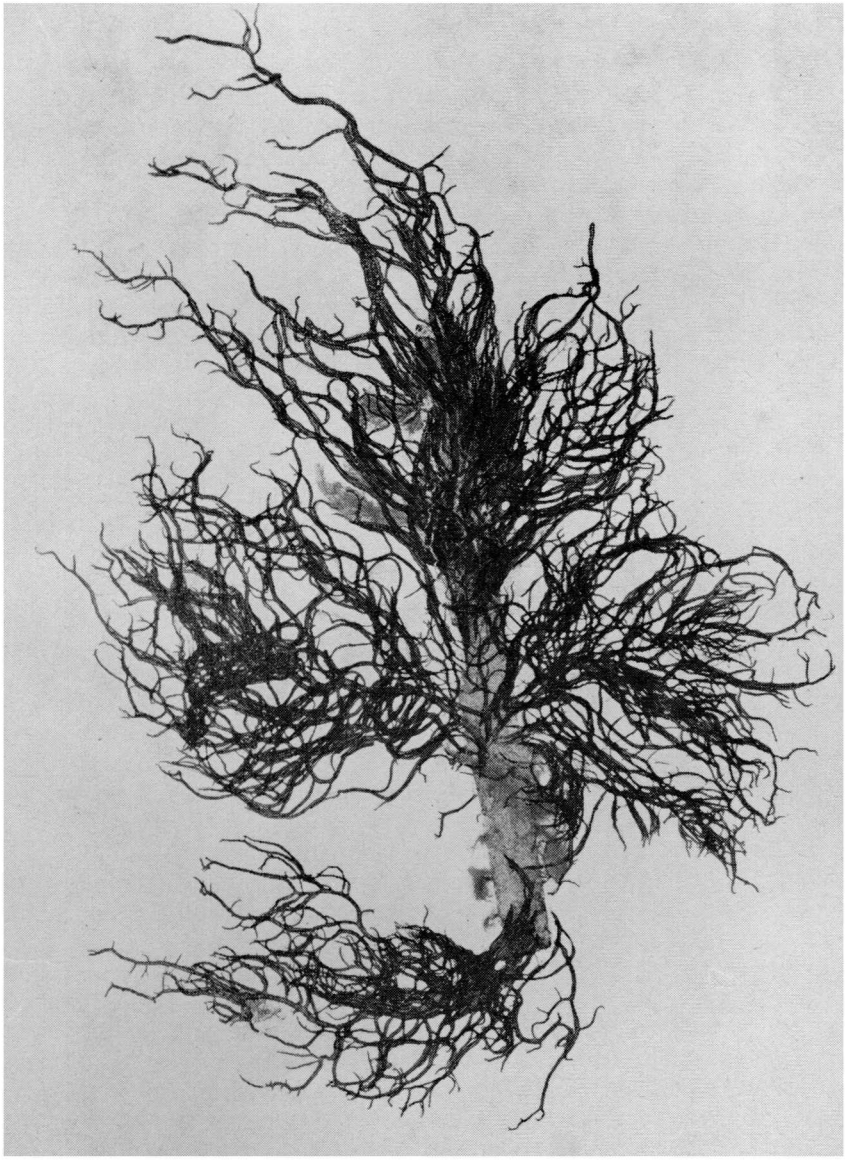

FIGURE 3. A leaf of *Thalassia* with a heavy stand of the seasonal brown alga, *Cladosiphon occidentalis,* which is abundant in the south Florida area during winter and spring. Other algae on this leaf include *Melobesia membranacea,* forming an almost solid layer of calcified disks, and two small, filamentous species, *Giffordia mitchellae* and *Cladophora delicatula.*

The coralline species are year-around and while they occur on larger algae as well as sea grasses, the extent of development found on sea grass leaves is rarely ever encountered on any other host or substratum.

The second group of epiphytes are those that commonly occur on sea grass leaves and complete their life histories in this habitat but also occur on other hosts or on non-living substrata (Fig. 2). These are mostly small, filamentous, or delicate species that do not grow so large as to lose their hold on the leaf or to pull the leaf loose when they reach maturity or full size. Examples of these occur in the genera *Entophysalis, Lyngbya, Phormidium, Schizothrix,* and *Calothrix* of the bluegreens; *Asterocystis, Erythrotrichia, Achrochaetium, Crouania, Callithamnion, Griffithsia, Ceramium, Spyridia,* and *Polysiphonia* of the reds; *Ectocarpus* and *Giffordia* of the browns; *Phaeophila, Ulvella, Enteromorpha, Ulva, Chaetomorpha,* and *Cladophora* of the greens. While the sea grass epiphytes of these genera do not depend upon sea grasses as a most important substratum, the presence of sea grasses (in lieu of a sandy or muddy bottom) results in a great increase in the abundance of these species.

The third type of sea-grass epiphyte is that group of algae which attaches to sea grasses only fortuitously. In general, these plants become so large that they always break loose or break off the leaf before they reach maturity because of the increasing resistance to waves and currents as they grow. They are much more abundant on hard, non-living substrata such as shells and stones, and with the exception noted below, their abundance in an area is not significantly increased by attachment to sea grasses. The following genera include examples of these: *Dasya, Heterosiphonia, Acanthophora, Chondria,* and *Laurencia* of the reds; *Dictyota* and *Padina* of the browns; some species of *Enteromorpha* and *Cladophora,* and *Anadyomene* of the greens.

There are several genera and species in this category, however, that are very much favored by the readiness with which the plants become attached to *Thalassia.* These are *Hypnea musciformis, Spyridia filamentosa,* and to a lesser extent *Agardhiella tenera* and several species of *Gracilaria.* Young plants of these species become very abundant on *Thalassia,* especially in the Tampa Bay area of the Florida Gulf coast in the late summer and fall. As these plants become relatively large, they tend to break loose from the leaves but since *Thalassia* flats in this area are generally in localities of low current velocity and wave action, the loose plants continue to grow among the *Thalassia.* During the period December to February, strong northeast or northwest winds occur in relation to cold air masses moving south and these are sufficient to move the masses of loose seaweed and cause them to wash ashore or to accumulate in deep layers in shallow bays. They often move against the wind because of the counter currents created on the bottom by the wind-driven surface currents.

Piney Point, where the ferry boats from St. Petersburg formerly docked on the mainland side of Tampa Bay, has always been an area of great accumulations of this mass of drifting algae during winter and early spring (Humm, 1944).

There is some evidence that these large algae are able to grow upon *Thalassia* leaves because of the "pioneering" of the disk-forming coralline red algae. The dead layer of calcified cells of the corallines provides an excellent place of attachment for spores of other species, apparently a more favorable place than the bare surface of the *Thalassia* leaf itself.

Epiphytes upon Epiphytes.—The many epiphytes upon the algae that grow upon *Thalassia* have not been included in this list upon the assumption that they bear no significant relationship to the ecology of *Thalassia.* A wide variety of bluegreens was observed, including several species of *Anacystis* (all of which probably occur also on *Thalassia*), two microscopic greens that may be worth mentioning: *Diplochaete solitaria* Collins and *Entocladia viridis* Reinke, both of which were very common. Many others could be added.

A Key to the Algae Epiphytic on *Thalassia* in the Miami Area

I. *CYANOPHYTA*

The Bluegreen Algae

Single-celled, in colonies, or filamentous, the cells without a distinct nucleus, the pigments not localized in chromatophores but dissolved in the outer cytoplasm. Cells, colonies, or filaments usually covered with a sheath or gelatinous matrix of a polysaccharide. Plant masses usually green, bluegreen, or blackish but sometimes other colors are predominant. Cells under a microscope usually green to bluegreen. The individual cells or filaments are microscopic, but plant masses, layers, or tufts are usually visible to the unaided eye. Common as epiphytes, but also abundant on stones, shells, seawalls, pilings, mangrove roots, especially in the intertidal zone. These are the most primitive of all plants.

1. Plants not distinctly filamentous (except that portion which has penetrated limestone) 2
1. Plants filamentous 3

2. Individual cells, small groups, or a cushion of cells directly attached to *Thalassia* leaves ..... *Entophysalis conferta*
2. Cells attached to and usually also embedded in some form of limestone upon the *Thalassia* leaf ..... *Entophysalis deusta*

3. Filaments without crosswalls (unicellular), 1-2 microns in diameter, forming a regular spiral ..... *Spirulina subsalsa*
3. Filaments with crosswalls (multicellular) 4
4. Filaments forming a loose spiral with about one turn per cell ..... *Arthrospira miniata*
4. Filaments not forming a distinct spiral 5
5. Filaments without an obvious sheath, the cells 6-10 microns in diameter, 3-4 microns long ..... *Oscillatoria corallinae*
5. Filaments with a sheath or in a gelatinous matrix 6
6. Both basal and intercalary heterocysts present .. *Calothrix crustacea*
6. No heterocysts present 7
7. Filaments embedded in a rather firm gelatinous matrix, usually hemispherical in shape, the cells 1-2 microns in diam ..... *Schizothrix calcicola*
7. Filaments not embedded in a gelatinous matrix, although a sheath is present 8
8. Cells 14-30 microns in diameter, 4-10 microns long, usually not densely cytoplasmic ..... *Lyngbya sordida*
8. Cells not exceeding 16 microns in diameter 9
9. One to several filaments in a sheath, cells 8-16 microns in diameter, granules at the crosswalls .... *Hydrocoleum lyngbyaceum*
9. Always one filament within the sheath, cells 1.5-3.5 microns wide, 2.5-6 microns long, slightly constricted at the nodes ..... *Symploca laete-viridis*

II. *RHODOPHYTA*

The Red Algae

About 60 per cent of the algal epiphytes of *Thalassia* are red algae, and they are the most diversified group. Among them is a large number of very small species adapted for a holoepiphytic existence. Most red algae are readily recognized as Rhodophyta by the predominance of the red pigment. However, the greatest variation in color of any algal phylum occurs among the red algae, and some species are often found with the chlorophyll pigments predominating so that they have the color of true green algae. *Hypnea musciformis* and *Gracilaria foliifera,* for example, are usually green or purplish green. The microscopic epiphyte *Asterocystis ramosa* is apparently always grayish green or steel green. Others may be yellow-brown, a color sometimes found in some species of *Chondria* or *Agardhiella tenera,* especially if they have grown in shallow, clear water. Members of the family Corallinaceae may be pale pink or purple or even white. Some species of *Polysiphonia* are purple black.

1. Plants microscopic, or essentially so, and without slender protoplasmic connections between cells 2
1. Plants microscopic to large, with slender protoplasmic connections between cells 5

2. Plants forming a microscopic disk of radiating red filaments on *Thalassia* and other hosts ..... *Erythrocladia subintegra*
2. Plants filamentous and erect 3

3. Unbranched ..... *Erythrotrichia carnea*
3. Branched 4

4. Cells elongate, the contents greenish-gray .... *Asterocystis ramosa*
4. Cells short, the contents red ..... *Goniotrichum alsidii*

5. Plants forming a flat, white to rose colored disk, mostly 1-3 mm. in diameter; protoplasmic connections obscured by heavy calcification of the cells 6
5. Plants not in the form of a flat disk 9

6. Tetrasporangial conceptacles with numerous pores ..... *Melobesia membranacea*
6. Tetrasporangial conceptacles with one pore 7

7. A colorless, swollen cell terminating each cell row of the vegetative part of the disk ..... *Fosliella farinosa*
7. Without colorless, swollen cells (trichocytes) 8

8. Disks 1-cell thick at the margins, 2-4 cells thick near the center; tetrasporangia 50-80 microns long ..... *Fosliella lejolisii*
8. Disks more than one-cell thick at the margins; tetrasporangia 80-130 microns long ..... *Lithophyllum pustulatum*

9. Plants heavily calcified, dichotomously branched 10
9. Plants not calcified 11

10. Branches less than 100 microns diameter, the segments mostly 4-6 diameters long ..... *Jania capillacea*
10. Branches over 100 microns diameter in the basal parts, segments 2-4 diameters long ..... *Jania adhaerens*

11. Plants essentially microscopic, less than 1 mm tall 12
11. Plants larger 13

12. Inhabiting sertularian hydroids on *Thalassia* .... *Kylinia infestans*
12. On *Thalassia* itself; with a single persistent basal cell, cells of the branches cask-shaped ..... *Kylinia crassipes*

13. Branches, flat, thin, lanceolate 14
13. Branches filamentous or terete 15

14. Blades curved, the tips involute, midrib evident ..... *Hypoglossum involvens*
14. Blades flat, straight, midrib not evident to the unaided eye ..... *Hypoglossum tenuifolium*
15. Branches hollow, at least at the center; not uniseriate 16
15. Branches uniseriate, or if pluriseriate or parenchymatous not hollow 18
16. Branches of barrel-shaped segments ..... *Champia parvula*
16. Branches not of barrel-shaped segments 17
17. Branches mostly 1 mm or less in diameter ... *Lomentaria baileyana*
17. Branches over 1 mm (to 4) in diameter, plants mostly 6-10 inches tall, much branched, the narrow hollow center with loose filaments ..... *Agardhiella tenera*
18. Plants filamentous with both main axes and branches uniseriate; corticating cells, if any, restricted to the nodes; in Crouania, the branches are short and dense and conceal the main axis 19
18. If, filamentous, not uniseriate throughout; or not filamentous ... 29
19. Main axes covered with whorls of short, dense branchlets, the plants very gelatinous 20
19. Main axes evident through the branchlets or not at all concealed by the branchlets 21
20. Axes, including branchlets, 0.2-0.5 mm in diameter, tetrasporangia single in each branchlet fascicle .... *Crouania attenuata*
20. Axes, including branchlets, 0.5-1.0 mm in diameter; tetrasporangia several in each fascicle ..... *Crouania plenospora*
21. Main axes 200-225 microns diameter, covered with compound determinate branchlets; plants 1-1.5 cm. high .... *Wrangelia argus*
21. Main axes not bearing determinate branchlets (except for colorless hairs in some) 22
22. Without small corticating cells surrounding the nodes 23
22. With small corticating cells surrounding the nodes 27
23. Cells barrell-shaped to beadlike, especially in the upper parts of the plant, and bearing branched colorless hairs at their upper ends *(Griffithsia)* 24
23. Cells not notably swollen and without colorless hairs at their distal ends 26
24. Cells swollen only a little, especially in the upper parts of the plant 25
24. Cells swollen to nearly spherical ..... *Griffithsia globulifera*

25. Tetrasporangia single on the upper ends of the basal cells of the hairs; cystocarps on one celled stalks .... *Griffithsia barbata*
25. Tetrasporangia in groups at the nodes on short stalks ... . *Griffithsia tenuis*
26. Terminal few cells of branches 10-20 microns in diameter and about 4 diameters long, the tip cell obtuse *Callithamnion halliae*
26. Terminal few cells of branches about 8-10 microns in diameter, 5-8 diameters long or more, the younger often with hair tips only 3 microns wide; cystocarps double and trilobed; tetrasporangia 27 x 40 microns .. *Callithamnion cordatum*
27. Lower cells of the corticating band at the nodes wider than long ..... *Ceramium byssoideum*
27. Lower cells of the corticating band not wider than long 28
28. Nodal cortication of one row of small and one row of large cells, with few exceptions, internodes about 50 microns in diameter ..... *Ceramium fastigiatum*
28. Nodes typically with three layers of cells; internodes to 120 microns diameter and up to 10 diameters long *Ceramium subtile*
29. Plants bearing determinate branchlets that are uniseriate and with pigments; these may be corticated at the nodes (like *Ceramium)* or not corticated 30
29. Plants without colored, uniseriate determinate branchlets 40
30. Ultimate branchlets with a few corticating cells at the nodes (like *Ceramium)* and spine-tipped *(Spyridia)* 31
30. Ultimate branchlets without corticating cells 32
31. Branchlets with a single terminal spine only, plants usually without one distinct main axis ..... *Spyridia filamentosa*
31. Branchlets often with curvel lateral spines on the terminal or penultimate node in addition to the terminal spine; plants usually with one distinct main axis ..... *Spyridia aculeata*
32. At least two axis segments between the origin of the branches or branchlets; branches and branchlets tending to be distichous 33
32. Branchlets arising from every node, at least potentially 34
33. Plants 1-5 cm tall (or long, if creeping); main axis with six pericentral cells, uncorticated .... *Heterosiphonia wurdemanni*
33. Plants 5-15 cm tall; main axes heavily corticated .... *Heterosiphonia gibbesii*
34. Branches and branchlets arising from opposite sides of the axes and principally alternate though sometimes opposite in the upper parts of the plant ..... *Wrangelia penicillata*
34. Branches and branchlets not distichous 35

35. Upper parts of main branches bearing both monosiphonous branchlets and short, spinelike polysiphonous branchlets ..... *Wrightiella tunmanowiczii*
35. Utimate determinate branchlets all monosiphonous, or at least with long, monosiphonous tips *(Dasya)* 36
36. Main branches without corticating cells, or a central row and five pericentral rows of cells; plants 1-2 cm tall . *Dasya rigidula*
36. Main branches covered by corticating cells 37
37. Ultimate branchlets in ocellate clusters at the branch tips; plants only 2-4 cm tall, densely branched ..... *Dasya collinsiana*
37. Without ocellate clusters of branchlets at the tip; plants over 4 cm tall when mature 38
38. Plants 5-12 cm tall, densely branched, the main axes about .75 mm diameter ..... *Dasya corymbifera*
38. Plants 15-30 cm tall or more when mature, usually not densely branched 39
39. Cystocarps sessile; plants not common but year-around .. .. *Dasya harveyi*
39. Cystocarps pedicellate; plants abundant during winter and spring, rare or absent at other seasons ..... *Dasya pedicellata*
40. Plants filamentous throughout (but not uniseriate except for colorless hairs) 41
40. Plants not filamentous, although they may be small and may bear filamentous, determinate branchlets 51
41. Plants of an axial row of large cells covered by a single layer of small corticating cells 42
41. Plants polysiphonous (a central row surrounded by three or more outer or pericentral rows of cells) 43
42. Filaments smooth, the nodes indistinct ..... *Ceramium nitens*
42. Nodes marked externally by a whorl of short spine-like protuberances; apices forcipate ..... *Centroceras clavulatum*
43. Pericentral cells (or row) three ..... *Falkenbergia hillebrandii*
43. Pericentral cells four or more 44
44. Pericentral cells four 45
44. Pericentral cells numerous; plants with creeping or horizontal main axis 50
45. Main branches considerably corticated and bearing simple or forked determinate branchlets 2-5 mm long .... *Polysiphonia ramentacea*
45. No cortication over the pericentral cells or only a little at the base of the plant 46

46. Apical cell exposed because of the absence or sparcity of trichoblasts (colorless hairs) ..... *Polysiphonia subtilissima*
46. Apical cell usually obscured by an apical cluster of deciduous trichoblasts 47

47. Plants coarse, 4-12 cm tall, the segments mostly about as wide as long, the branches bearing numerous pointed branchlets about 2 mm long ..... *Polysiphonia hapalacantha*
47. Plants without numerous 2 mm branchlets 48

48. Branching notably dichotomous from a single main axis; plants 1-2 cm tall, common on *Thalassia* .. *Polysiphonia gorgoniae*
48. Branching not notably dichotomous, mainly alternate 49

49. Main filaments less than 100 microns in diameter .... *Polysiphonia havanensis*
49. Main filaments 100-300 microns in diameter, the segments equal to or shorter than their diameter ..... *Polysiphonia binneyi*

50. Main axis with a branch, branchlet, or rudiment from each node, largely free of the substratum; determinate branchlets with 8-10 segments, the tips strongly down-curved ..... *Herposiphonia pecten-veneris*
50. Main axis with a determinate erect branch about every fifth node, erect branches with 12-15 segments .. *Herposiphonia secunda*

51. Main axes rigid, 2-3 mm in diameter, and clothed with a dense stand of stiff determinate branchlets 3-5 mm long and polysiphonia-like in structure ..... *Digenia simplex*
51. Main axes without slender determinate branchlets 52

52. Branch tips with a cluster of trichoblasts 53
52. Branch tips bare 60

53. Branchlets with numerous, short, spine-like protuberances ..... *Acanthophora spicifera*
53. Branchlets without spine-like protuberances 54

54. Branchlets much constricted at the base; pericentral cells forming a distinct circle as seen in cross-section 55
54. Branchlets only slightly or not constricted at the base; pericentral cells indistinct in main axes 59

55. Branch tips acute, the growing point exposed; plants 2-3 cm high, or creeping ..... *Chondria polyrhiza*
55. Branch tips blunt, the growing point sunken 57

56. Plants mostly 1-5 cm tall, year-around 58
56. Plants usually 5-10 cm tall, a winter and spring species in south Florida ..... *Chondria baileyana*

57. Thick end-walls of the pericentral cells visible through the cortex; main axes 0.4-0.75 mm in diameter . . *Chondria collinsiana*
57. Pericentral cell end-walls visible through the cortex; main axes 0.2-0.35 mm in diameter . . . . . *Chondria curvilineata*

58. Plants relatively soft, paniculately branched, the axes yellow or green, the branchlets rose colored . . . . . *Laurencia obtusa*
58. Plants relatively stiff, alternately or irregularly branched, pale buff to reddish brown, the ultimate branchlets peg-like . . . . . *Laurencia poitei*

59. Plants densely-branched the main branches bearing numerous, short spur branchlets; ends of main branches sometimes with swollen hooks . . . . . *Hypnea musciformis*
59. Plants moderately branched, without any distinctive short branchlets . . . . . *Gracilaria foliifera*

III. *PHAEOPHYTA*

The Brown Algae

Unlike the red algae, the brown algae are always brown in color and usually recognizable at a glance. When preserved, or if kept under anaerobic conditions before preservation, the brown pigments may be decomposed or leached out more rapidly than others and the resultant color may be green or yellow. Brown algae make up about 17 per cent of all *Thalassia* macro-algal epiphytes.

1. Plants filamentous and uniseriate throughout 2
1. Plants not filamentous, or if filamentous not uniseriate throughout 9

2. Sporangia spherical or nearly so, 30-40 microns in diameter; main branches with many short branches arising at right angles . . . . . *Acinetospora pusilla*
2. Sporangia or gametangia not spherical or subspherical 3

3. Gametangia borne in clusters or opposite, about 25 microns wide, 40 microns long; plants with a disk-like base of closely-appressed filaments, the branches usually terminating in colorless hairs with basal growth . . *Myriotrichia subcorymbosa*
3. Gametangia not opposite or in clusters 4

4. Plants not over 5 mm tall 5
4. Plants usually over 1 cm tall 7

5. Gametangia widest below the center and with pointed tips, 27-40 microns wide, 80-120 microns long . . . . . *Giffordia rallsiae*
5. Gametangia not distinctly widest below the middle 6

6. Gametangia borne almost entirely near the base of the plants, the erect filaments unbranched except at the base ..... *Ectocarpus elachistaeformis*
6. Gametangia on both upper and lower parts of the plant; erect branches 9-12 microns in diameter .... *Ectocarpus variabilis*
7. Gametangia cone-shaped, widest at the base, and usually 2-4 in a row along a branchlet ..... *Giffordia conifera*
7. Gametangia elongate and blunt at the tip 8
8. Main axes 35-50 microns in diameter, gametangia 20-30 microns in diameter, 50-150 microns long, usually less than than 5 diameters long; plants 2-20 cm or more tall ..... *Giffordia mitchellae*
8. Main axes 20-35 microns in diameter, gametangia 20-50 microns in diameter, 110-250 microns long, usually over 5 diameters long; plants not exceeding 2 cm in height ..... *Giffordia duchassaigniana*
9. Plants flattened, never hollow; year-around 10
9. Plants round in cross-section, or if flattened in part they are hollow; present during winter and spring 13
10. Plants producing orbicular blades with a rolled margin, often lightly calcified .....*Padina sanctae-crucis*
10. Plants of strap-shaped branches, dichotomous, and with a prominent apical cell 11
11. Branches 1-2 mm wide at the base but tapering to about 0.2 mm width in the upper parts ..... *Dictyota divaricata*
11. Branches mostly exceeding 2 mm in width 12
12. Distance between branches only about 4 branch widths, branching wide-angled, the plants often entangled with each other ..... *Dictyota bartayresii*
12. Distance between branches over 5 branch widths, branch angles usually 45-60°, plants not noticeably entangled ..... *Dictyota dichotoma*
13. Plants unbranched or sparingly branched, mostly 5-10 cm tall, main axes about 1 mm in diameter .. *Stictyosiphon subsimplex*
13. Plants abundantly branched, the branches thicker 14
14. Plants extremely soft and slippery, branches 0.75-2 mm diameter, the plants almost exclusively on sea grasses, winter and spring ..... *Cladosiphon occidentalis*
14. Plants not unusually soft and slippery, branches 2-5 mm diameter except near ends where much narrowed; rather rare in the Miami area ..... *Rosenvingea intricata*

IV. *CHLOROPHYTA*

The Green Algae

The green algae are probably the easiest to recognize of any of the four major groups. However, two of the most difficult genera are to be found in this group and are common on *Thalassia: Enteromorpha* and *Cladophora*. About 13 per cent of the *Thalassia* epiphytes are Chlorophyta.

1. Plants single-celled and solitary, 25-30 microns in diameter, a colorless hair arising from each end of the cell ..... *Diplochaete solitaria*
1. Plants multicellular or coenocytic, or at least colonial 2

2. Cells embedded in a common gelatinous matrix of irregular shape which may be macroscopic; cells 3-7 microns in diameter and in groups of 2-4 ..... *Pseudotetraspora antillarum*
2. Plants not in the form of colonies 3

3. Plants virtually invisible without magnification 4
3. Plants macroscopic though they may be small 5

4. Plants forming a compact disk, the cells radiating from the center ..... *Ulvella lens*
4. Plants loosely filamentous, prostrate on the host, occasional cells giving rise to slightly spiral colorless hairs..... *Phaeophila dendroides*

5. Plants filamentous and uniseriate throughout 6
5. Plants not filamentous, or at least not uniseriate throughout 10

6. Filaments unbranched 7
6. Filaments abundantly branched *(Cladophora)* 8

7. Filaments entirely erect, 2-5 mm tall ..... *Chaetomorpha minima*
7. Filaments mainly prostrate, usually longer than a few mm and characteristic of quiet waters, not attached ..... *Rhizoclonium riparium*

8. Ultimate branchlets tending to be in clusters, the main axes usually over 150 microns in diameter . . *Cladophora fascicularis*
8. Main axes usually less than 100 microns in diameter, the ultimate branchlets not clustered 9

9. Main axes mostly 40-60 microns in diameter . . *Cladophora delicatula*
9. Main axes mostly 60-80 microns in diameter . . . *Cladophora sericea*

10. Plants forming a flat blade 11
10. Plants forming a branched or unbranched hollow tube, the walls one cell thick *(Enteromorpha)* 12

11. Blade with obvious radiating veins ..... *Anadyomene stellata*
11. Blade without veins ..... *Ulva lactuca*

12. Plants unbranched or branched at the very base only; cells in longitudinal rows, 10-28 microns in diameter ..... *Enteromorpha flexuosa*
12. Plants branched, but sometimes only a little above the base 13

13. Branching limited mostly to the lower part of the plant, cells in longitudinal rows, mostly 9-12 microns in diameter ..... *Enteromorpha lingulata*
13. Branching occasional to frequent in the upper parts 14

14. Plants very slender, filamentous-like; tubular only in the lower main axis, above with 2-3 cells in cross-section or uniseriate tips; typically unattached and entangled .... *Enteromorpha chaetomorphoides*
14. Plants tubular throughout except for uniseriate tips 15

15. Ultimate branchlets abruptly smaller than the axis bearing them and short, spine-like in appearance, often with uniseriate tips ..... *Enteromorpha salina*
15. Without distinctive, short ultimate branchlets 16

16. Branchlets ending in long, uniseriate tips, often opposite; plants usually small, delicate ..... *Enteromorpha plumosa*
16. Branchlets not ending in long uniseriate tips 17

17. Main axes usually 0.5 to 2.5 mm in diameter, the plants repeatedly branched ..... *Enteromorpha clathrata*
17. Main axes often over 1 cm in diameter, branches of the first order often arising along the margins of the flattened axis, second order branches not common ... *Enteromorpha prolifera*

Sumario

Epifitas de la Hierba Marina *Thalassia testudinum* en la Florida

Se reportan ciento trece especies de algas que se presentan como epifitas en la hierba marina *Thalassia testudinum*. Noventa y dos de éstas son reportadas en el sur de la Florida, alrededor del 20-25 por ciento de las algas de la flora marina del área. Se reconocen dos grupos de epifitas: las especies presentes todo el año y las estacionales. Las más importantes de las especies presentes todo el año son las Corallinaceae calcáreas del género *Melobesia* y *Fosliella* por la extensión con la que frecuentemente cubren las hojas y por su contribución a los sedimentos de los lechos de *Thalassia* cuando mueren las hojas. Entre las estacionales hay un grupo

de grandes plantas *(Cladosiphon, Eudesme, Ectocarpus, Enteromorpha, Ulva)* que durante el invierno y la primavera resultan tan abundantes en algunas áreas como para competir significativamente con *Thalassia*, por la luz.

Stictyosiphon subsimplex y *Polysiphonia harveyi* son nuevos reportes para la Florida; *Griffithsia barbata* es reportada en las Bahamas. Cada epifita de *Thalassia* es anotada y se da una clave para las del sur de la Florida.

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